BETTER FRUIT

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SMALL FRUIT SPECIAL

LOGANBERRIES
Grown in the Willamette Valley

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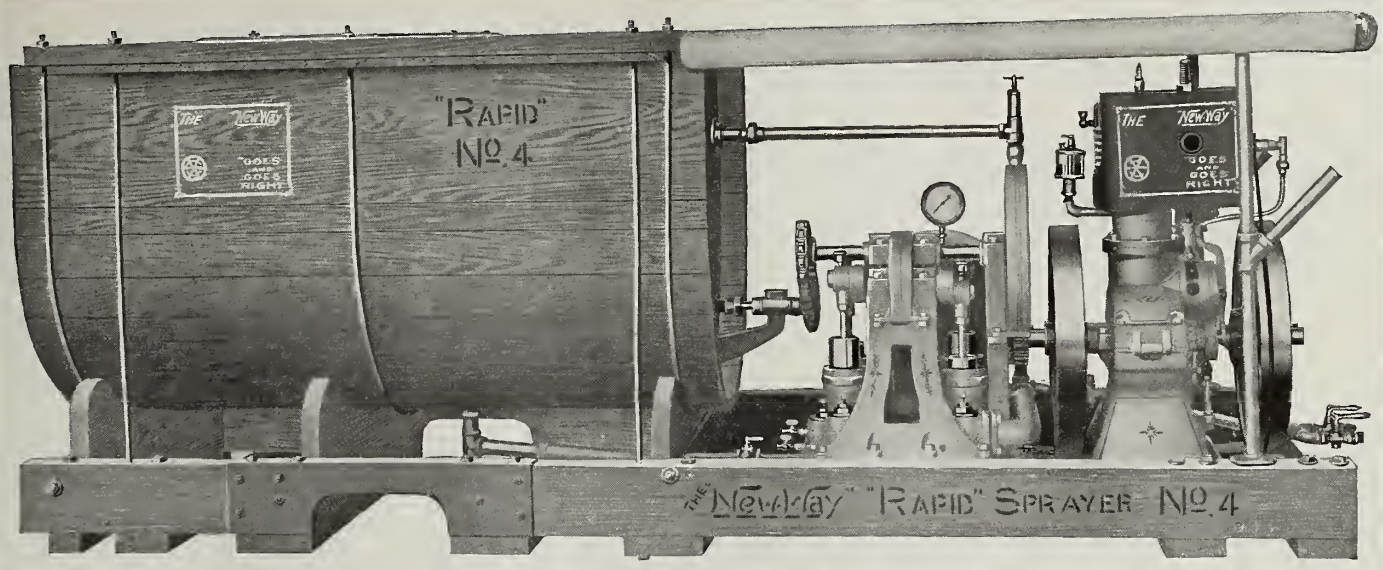

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BETTER FRUIT

AN ILLUSTRATED MAGAZINE PUBLISHED MONTHLY IN THE INTEREST OF MODERN, PROGRESSIVE FRUIT GROWING AND MARKETING

Sites and Soils for Small Fruits in the Pacific Northwest

By C. I. Lewis, Chief Division of Horticulture. Oregon Agricultural College Experiment Station, Corvallis

IN choosing the location for a small fruits plantation one has to take many points into consideration. First, there are certain climatic conditions which will determine to a large degree whether certain of our small fruits can be grown to advantage. The rainfall or the possibilities of having an abundance of irrigation water are very important factors. With some of our small fruits the rainfall plays a roll which probably even irrigation cannot supplement in all cases, owing to the fact that in regions of considerable rainfall the moisture content of the atmosphere at times is apt to be greater than in some of the arid belts. With certain of the cane fruits and brambles it has been demonstrated that they grow to the greatest degree of success on a rich soil abundantly supplied with humus and moisture and an atmosphere which is not too dry.

The winter temperature will in some cases be a determinate. Especially is this true where one is attempting to grow the evergreen types like the Evergreen blackberry, Loganberry, Phenomenal, etc. Summer heat also has an influence, at times producing a condition which is unsatisfactory to certain forms but being of distinct advantage to others. The fall temperature, that is, the suddenness with which the growing season terminates is to be considered where certain more tender forms are being grown. The length of the growing season and the altitude also play a very important part. The soil has an important roll, especially since some of our cane fruits depend so much upon a cool, moist condition of the soil. Most of our small fruits demand very good drainage. It is evident, then, that soils of this type must be chosen, and in most cases the richer the soil the better.

The response of a plant to natural conditions is shown by an example that we can give of the Evergreen blackberry. Where it is grown wild in Western Washington and Western Oregon the berries are small, hard and sour, but where it is grown wild in our coast and mountain regions it is very luscious and hardly seems like the same fruit. It is only by bringing about good conditions, by following good tillage, pruning and feeding, that one can produce the Evergreen blackberry to the highest degree of perfection. In addition to the natural surroundings I want you to also take into account the possibilities of shipping, and at times the possibilities of using the fruits in the form of by-products. Here on the Pacific Coast we have a tremendous range of climatic conditions, elevations from sea level to the limit of plant growth. We have rainfalls that sometimes range from over one hundred inches to a few inches. Our soils vary from the heaviest of adobe to the lightest of sand, silt, ash and pumicestone. There is such a tremendous range of climate and soil conditions that the problem of small fruit culture in any one region becomes largely a local one and in many cases must be solved by local experiments, but after all these tremendous ranges of climatic conditions are of wonderful assistance to us in that they extend our range of crop production and make it possible to grow more types and varieties than would otherwise be possible.

Features of this Issue

I will mention first some points in the Northwest, which we will divide into areas, largely according to climatic conditions. First comes the western coast region of Oregon, Washington and British Columbia. This includes the famous Puyallup Valley of Western Washington, in which the Evergreen blackberry is grown to the highest degree of perfection. The islands in the Sound, the lower mainland of British Columbia and such counties in Western Oregon as Clatsop, Tillamook, Lincoln and Coos are all included in this class. This region is subject to a fairly heavy rainfall, has a long growing season and quite a range of soils, although the predominant soils are clay loams. In this region the brambles, loganberries, raspberries and blackberries grow to a wonderful degree of perfection. There is probably no section in the United States where such fruits will yield more heavily or grow more vigorously and rank than in this section named. The climatic conditions are such that a tremendous area of these fruits should be planted. Canning factories, evaporators and similar plants should be established in many quarters, while those that are advantageously located as far as shipping points are concerned should ship out large quantities of fruit.

The bench lands of this region produce very good strawberries, and the strawberry under these conditions tends to bear for a longer season, bearing two or three crops. I have picked them abundantly as late as the middle of September. The clay loams, and even some of the tide lands, seem to grow loganberries and blackberries very nicely. The sandy and silt loams are splendidly adapted to raspberries. Red raspberries, under such conditions, grow very vigorously. I have seen canes ten feet long that have borne fruit to the very ends of the canes and the yields are unusually high. Reports of yields as high as 500 and 600 crates per acre of red raspberries have come from the Puyallup district.

Between the coast range and the Cascades there are a number of valleys, especially in Western Oregon, such as the Rogue, Umpqua and Willamette. The famous Bear Creek bottoms of the Rogue River are ideal for dewberries, raspberries, loganberries, etc. In fact any class of small fruit thrives well along the river and its tributaries and a much greater industry should be built up than now exists. Strawberries, of course, can be grown all over the Northwest. In the Umpqua Valley all classes of small fruits succeed. The region is becoming famous for its very early strawberries, being one of the very earliest regions in the entire Pacific Northwest. The low altitude and the shelter obtained from the mountains result in early maturing. This section should devote more time and energy to early produce of all kinds. In the Willamette Valley certain large sections are developing small fruits. In the Newberg district, on the red hill soils, raspberries, strawberries, blackcaps and loganberries are all thriving. There is a tremendous area of land in the Willamette Valley adapted to small fruits. The sandy and silt soils of the river bottom lands, such as the Mission bottoms at Salem, will produce small fruits of all classes. The yields are very high. At Russellville and vicinity quite a small fruit development has taken place, and in the sandy loams of that region the

raspberry thrives especially well. Then we have the inland mountain regions, like Hood River and White Salmon, that have become famous for their strawberries, and while many other small fruits could be successfully grown, the reason they are not grown is that the growers have not attempted to grow them. The strawberry has been the pioneer crop and has been grown until the orchards come into bearing.

In the inland valleys of the Inland Empire small fruit culture at times becomes very profitable. Such regions as Kennewick are early and the stony soils of the Walla Walla Valley are extremely early. They warm up very rapidly in the spring. All along the Columbia River fine strawberry lands can be obtained. In the Payette Valley of Idaho one finds the blackcap being grown successfully under irrigation. There is not a valley in all that wonderful territory but what can grow some form of small fruit to the highest degree of perfection. Gooseberries and currants will be the least successful owing to the fact that both these crops like cool weather and a cool, moist soil. Where dry soils are found and combined with rather dry weather conditions it will be advisable to plant the gooseberry and currant in close proximity to a building, generally on the north side; or, if this is impossible, you could plant them among the fruit trees where they get some coolness and shade from the trees.

The strawberry has the widest range of adaptability of any fruit we are growing in America. It is being grown from Alaska to Southern California and from Maine to Florida. While it is true that in some of these regions it is necessary to ship the plants in, it being impossible to produce the young plants that will fruit successfully in the region, nevertheless a profitable business is carried on in all these states. In the Pacific Northwest, as far as the strawberry is concerned it becomes very largely a local problem. There are practically very few soils but what the strawberry will succeed on. Those which are too dry or contain an excess of alkali or an accumulation of some injurious salt would not be desirable, but the average loam which has good air and soil drainage will produce some variety of strawberry, and one has the privilege of choosing from many hundred varieties. In the Inland Empire and in some of the moutnainous valleys we find the Clark Seedling to be the leading berry, but in other sections the Magoon, Sixteen-to-One, Senator Dunlap, Gold Dollar, Wilson and similar varieties are found to be most profitable. While it is true that strawberries can be grown in practically every region of the Northwest, certain regions like Vancouver Island, parts of the Walla Walla, the Umpqua, Hood River, White Salmon and selected portions of the Willamette Valley will become noted more, commercially, than other sections in the production of this berry.

The red raspberry thrives the best in the sandy and silt loams, and in Western Oregon and Washington, under the climatic conditions that prevail, they will respond to tremendous feedings of manure, especially where liquid manures can be applied the returns will be very gratifying. Our falls and winters are such that there is not the danger of winter killing that one finds in the eastern part of the United States when excess amounts of nitrogenous fertilizers are applied. The raspberry does not like cool soils or those which are poorly drained. Wherever it is possible to keep up a good moisture supply one should always choose the sandy or silt loams, not that the plants will not grow on other soils, but these are the types that will prove to be the most profitable.

The black cap industry has been somewhat neglected on the Pacific Coast as a whole. Around Newberg there is quite an area of this berry being grown and in the Puyallup Valley they are being grown very successfully. It is a lover of deep, well drained moist loam and prefers a soil that is cool and abundantly supplied with humus. In the Inland Empire it thrives the best where the soil is somewhat shaded and kept cool by irrigation waters. The system that Mr. Sherman uses in the Payette Valley is subject to these conditions. We find the general requirements quite different to those necessary for the red raspberry, although the blackcap is by no means confined to this one type of soil. The river-bottom soils of Western Oregon will all grow good blackcaps. It must be kept in mind that unless one can maintain a proper moisture supply, have good drainage and tillage that it is foolish to grow the blackcaps, as they become small, hard and dry before anything can be done with it.

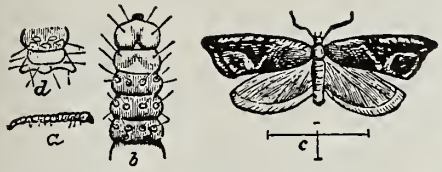
The blackberry offers an investment which should receive more attention. I have had cannerymen tell me repeatedly in Oregon that they could use five hundred acres of blackberries if they could procure them. The blackberry seems to thrive much better west of the Cascades than it does east. We find in the lower mainland of British Columbia that the blackberry has proved very profitable and in the Puyallup Valley the Evergreen is one of the most profitable berries grown. In the Willamette Valley and in the Rogue River Valley blackberries can be grown to a wonderful degree of perfection and ease, not only including such types as the Kittatinny and Snider but the brambles types and running types, such as the Mammoth and Evergreen. Some of the valleys of the Inland Empire producing blackberries to very good advantage. It is fairly hardy and grows well in some of the higher valleys like North Powder. In Baker City I have seen very luscious blackberries produced, and all over the Northwest more berries should be grown for home consumption. The blackberry is a great feeder and demands a fertile soil, one which will hold its moisture easily and one that is well drained. Ordinarily the clay loams are preferred for this berry. If the soil is somewhat lacking in plant food stable manures or organic fertilizers should be applied, as the plant will not grow successfully unless heavily fed.

The Loganberry is found at the present time succeeding on soils ranging from the red hills down to the river bottoms. There is a difference of opinion as to which of these locations are the preferable. The writer has found splendid patches growing under all conditions. It is certain, however, that such river-bottom soils as the Mission bottoms of the Willamette (this name is simply given to represent a type which extends along the Willamette and its tributaries) produce very heavy Loganberry patches that are long lived. The Loganberry should not be grown where the temperature drops down to the vicinity of zero or is apt to remain low for any time. Unless plants are protected from the cold they will not thrive. While there are portions of the Inland Empire along the Snake River that can grow the plants without protection, in the greater area of that region the soils and atmospheric conditions are dry and the winter conditions are not of the best for this fruit. They do well in the coast regions and in the mountainous valleys of Western Washington and Oregon. Here the plant grows vigorously, is extremely productive and seems to find those conditions of soil and climate which produce maximum yields.

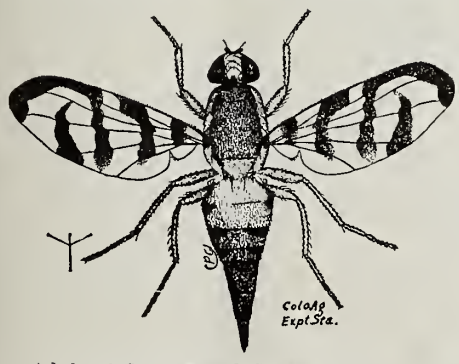
Great stories are often told of the production of gooseberries, and true it is that in Western Washington and Oregon this plant grows very luxuriantly. Very often within two years after setting the plants come into heavy bearing and give very satisfactory results. Some forms succeed better in the mountainous valleys of Western Oregon owing to the prevalence of mildew nearer the coast. The gooseberry likes cool, moist conditions. It will stand a northern exposure, more or less shade, a long growing season and cool weather. There are only certain types like the Red Jacket that seem to do well under the more or less arid conditions. What is true of the gooseberry is also true of the currant. Choose deep soils which have an abundant supply of plant food and moisture. A splendid income can be secured from both of these fruits. We could overdo the market if we all grew gooseberries and currants, nevertheless more people should become interested in these fruits.

All in all the Pacific Northwest is particularly fortunate in the ease with which small fruits can be grown. These industries should have had more careful study than they now receive. The possibility of by-products along these lines is almost unlimited and the time is coming with the opening of the Panama canal when such products can be handled very easily.

Grubs of the Chafer Beetle



Strawberry Leaf Roller
a, Larva, natural size; *b*, Head end of larva, enlarger; *c*, Moth, about twice natural size; *d*, Tail end of larva, enlarged. (After Saunders)



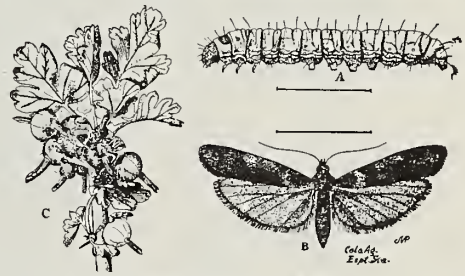
Adult of Currant and Gooseberry Fruit Maggot
Colorado Experiment Station

Strawberry Leaves, showing appearanee after being folded. (After Weed)

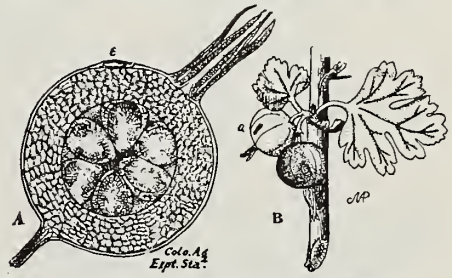
A Carrion Beetle that feeds on berries

Pupa of Strawberry Crown Borer issuing from plant

Strawberry Spittle Insect



Currant and Gooseberry Fruit Worm
a, Worm; *b*, Moth; *c*, Gooseberries webbed together. Original. Drawing by Miss M. A. Palmer, Colorado Experiment Station.



Currant and Gooseberry Fruit Maggot
a, Section through a gooseberry, showing egg and puncture at e; *b*, Two gooseberries on a stem, showing egg puncture or sting at a. Original. Drawings by Miss M. A. Palmer, Colorado Experiment Station.

Insects Affecting the Grape, Strawberry, Currant, Etc.

By A. L. Melander, Pullman, Washington

THE prinicpal insects attacking the grape in the Northwest are the phylloxera, leaf hopper, cutworm, grasshopper, flea beetle and wireworm. The disease called erinose has been rarely found in Washington. Without doubt the most serious of these troubles is the phylloxera, but fortunately this pest is but little distributed among our vineyards. The phylloxera insect is a small plant louse related to the aphis. It works, like the woolly aphis, both on the roots and above ground. Normally the root form is prevalent on European varieties of grapes, while the leaf form makes galls on American grapes. The insect seems to be especially poisonous and will kill the plants in a short time, particularly such varieties as seem not to be accustomed to its attacks. When the phylloxera is introduced to a vineyard, coming on nursery stock, the infested plants should be destroyed as soon as possible after noticing the attack. After the phylloxera has gained a foothold it is extremely hard to control, as it passes through the ground from one plant to the next, and presently the entire vineyard is affected. Spraying and fumigation have often been tried, but are far from being sucessful. In the infested districts immune plants must be grown, and these consist of European tops grown on American roots. The phylloxera is without doubt a dangerous insect and its introduction to the grape-producing districts would be a serious occurrence. Fortunately, up to the present it is restricted in the Northwest, but in California and France it has been a costly insect.

Now and then leaf hoppers do some damage to grapes, sucking from the leaves and causing them to drop early. Several methods of treatment have been suggested: Fanning the vines with tarred fans, which catch the hoppers when they jump; filling the air with a mist of weak kerosene emulsion to knock the hoppers to the ground and then following up with a stronger spray to kill the hoppers that were knocked to the ground; catching the hoppers by "shooing" them into a pan of crude oil fitted with a back-shield of wire fly screening; cleaning up rubbish in the fall so as to do away with hibernation quarters for the hoppers; these are all standard suggestions for treatment. Rarely, however, in Washington, have the leaf hoppers been troublesome enough to warrant the cumbersome treatments perscribed.

Bordeaux spray, made of lime and blue vitriol, is largely used as an insect repellant against such insects as chew up leaves. The copper it contains seems to give a metallic taste, which is much disliked by such insects as grasshoppers, flea beetles and cutworms. Should any of these species become injurious enough to require treatment, this simple remedy may be used. The general formula for bordeaux spray calls for six pounds of blue vitriol dissolved in twenty-five gallons of water and mixed with twenty-five gallons of lime water containing four pounds of lime. For the purposes of an insect repellant it makes little difference how the two liquids are mixed. There is much talk about the necessity of proper mixing to get most fungicidal value and least scorching effects, but our experiments conducted in this line on apple scab indicate that this point has been unnecessarily stressed. For cutworms it is best to supplement the bordeaux spraying with a poison-bait treatment. This consists of poisoned bran strewn on the ground near the plants. A convenient formula calls for one pound of paris green mixed dry with thirty pounds of bran; a little syrup is added, and if possible some stale beer, and then the mixture is worked to a paste by adding water. This may be left on the ground, a spoonful to a plant; but after a few days it is advisable to gather up the poison rather than to let

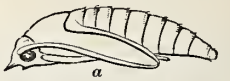
Continued on page 56

Fly of the Raspberry Cane Maggot

Shoots Wilted by the Cane Maggot

A Grasshopper

b

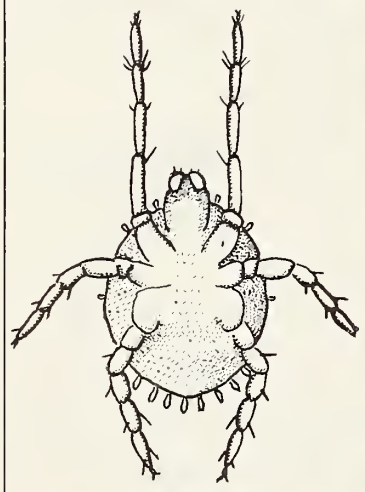


a

Strawberry Crown Borer and its Pupa

a. Stink Bug and its beak

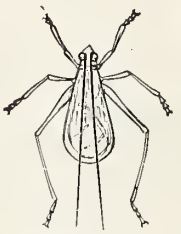
Moth of the Strawberry Crown Borer



Brown Mite

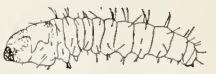
Pepper and Salt Currant Moth

Tarnished Plant Bug

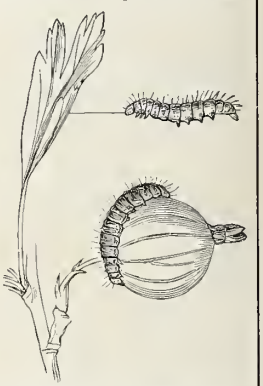


Snowy Tree Cricket, Male

Snowy Tree Cricket, Female



Overwintering Blackberry Crown Borer (enlarged 8 times)



Gooseberry Fruit Worm

Courtesy of Washington State College

Insect Pests and Diseases of Bush Fruits

By Professor W. H. Lawrence, Hood River, Oregon

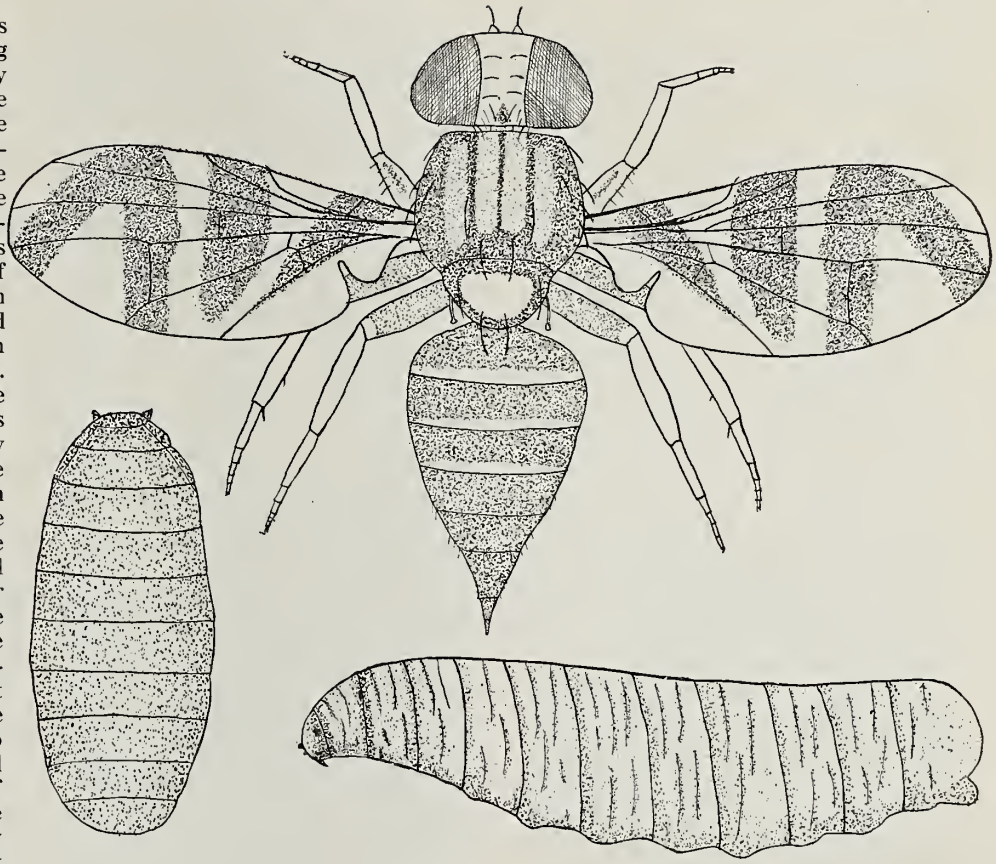
BLACKBERRIES, raspberries and their hybrids are attacked by a number of different species of insect pests and are susceptible to the attacks of fungi and bacteria. Fortunately all of these pests do not attack all of these bush fruits. Unfortunately, however, two or three of the best commercial varieties are attacked by a majority of the most destructive of these pests, as noted below in this article. The notes given deal very largely with the writer's experience during epidemics caused by bacteria and fungi and severe injuries caused by red spider and different species of insects. Some of these notes are only interesting from a scientific point of view. In all cases where damage was severe enough to take steps toward the control or eradication of the pest full notes are given. It is interesting in this connection to note that the Snyder among the bush blackberries, the Evergreen among the trailing blackberries, the Loganberry of the hybrids, the Antwerp of the red raspberries and the Cumberland of the black raspberries, all leading commercial sorts, are the varieties which are most severely damaged by one or more pests. Since this is true, the control of pests of bush fruits includes a number of very perplexing problems. A hint as to the control of these troubles through plant breeding is obtained through an inspection of the numerous varieties of bush fruits grown under cultivation. These suggestions point out the future solution of the problem, but for the present we must resort to the more common practices of pruning, burning and spraying. Notes of interest relative to the number of the troubles and the varieties on which they occur follow:

Crown gall is a very contagious bacterial disease. Among the bush blackberries the Snyder is the most susceptible, while the Erie and Early Harvest are damaged to a slight degree. Occasionally the Kittatinny and Lawton varieties are badly injured, yet this condition is the exception rather than the general rule. Among the trailing blackberries the Himalaya Giant, Mammoth and Evergreen, which are the varieties most commonly grown, the first named is by far the most susceptible to the disease. Even in this variety there is a vast difference in the severity of the disease, as it occurs under different conditions. The Snyder and Himalaya Giant are both about equally susceptible, and it is not uncommon to note galls located over the entire length of the canes. When the infection is serious and deep seated the results are disastrous. Loganberries, perhaps, rank third in suscpetibility. On this variety the galls more commonly occur on the roots, but may occur on the lower portions of the stems. Vast differences are noted in the susceptibility of the same variety of red raspberry plants from different sections. The Antwerp, which is recognized as a weak variety, is the most susceptible among the varieties. The galls may occur in the stems above ground situated in weather checks in the stem, but doing little or no injury to the plant, or the root systems may be thoroughly covered with galls of various sizes, injuring the plants so severely that they do not produce paying crops. In the diseases of bush fruits the blackberry is the one which suffers the greatest.

A brief description of the disease as it occurs on the blackberry will give a very good idea of its importance. Galls may occur on canes of both seasons' growth. They seldom occur on canes

of the current year's growth unless they have been injured in cultivating and training. Knots may appear at any time during the season. Knots on the old canes begin to appear by the middle of May in most cases. Growth continues throughout the season, but the greater amount takes place in the spring just before to a little after flowering time. The disease seldom attacks the crown of the plant. A majority of the knots are found on the main stem on the lower portion. Badly infested ones may be literally plastered with knots from the crown to the leaves. Galls have frequently been seen on the stalks of leaves and on a few occasions on the ribs of the leaves. The injury done depends on the location of the knots. They may occur in the pith, in the wood or in the bark. When the disease is abundant they seem to be pretty well distributed throughout all the parts. As the knots mature their influence on the stem and fruit is quite marked. Galls near the center of the stem cause them to split open. Occasionally canes are split the greater part of their length. Those knots under the laterals will cause the branches to break off. Those in the bark and wood also cause a greater or less splitting of the tissues. Galls that appear in the crotches of the branches frequently girdle them. The pressure exerted may also cause the lateral to split in the angle between stem and branch. Since the warts, or knots, mature in size after flowering it is not uncommon to see whole branches laden with partially developed fruit beginning to wilt. More often, however, the fruit matures fairly well in size, but it is dry and tasteless and of little value as a food. Being a bacterial disease, which is spread by various agents and is not controllable through spraying as far as has been determined, the diseased canes should be cut out and burned just as soon as the crop of fruit has been gathered. The bacteria causing the disease are in these galls and canes, and burning will destroy them, but this will not entirely control the trouble. It is suggested that the few plants which show crown gall below the ground should also be dug up and burned. A further recommendation is made to spray the plants with 6-4-50 bordeaux mixture just as early after the canes have been cut out as it is possible to do the work.

Anthracnose is one of the most destructive of the fungous diseases. Observations on practically all commercial varieties of blackberries and raspberries shows that the Snyder, Kittatinny and Himalaya Giant blackberries; the Lucretia dewberry, Loganberry and Phenomenal; the Antwerp and Cuthbert red raspberries and the Cumberland black raspberry are the most susceptible; in fact these varieties are the only ones on which the fungus causes injury affecting the growth of plants and yield of fruit. Of the above list, no two varieties are affected similarly. In general the attacks on raspberries, both red and



Courtesy of Washington State College
Dark Currant Fly, with Maggot and Pupa

black, are alike, being confined to the leaves and stems. The Lucretia dewberry is also similarly affected on leaves and stems, and with considerable injury to the fruit as well. The Kittatinny, which is attacked in the same manner and on the same portions of the plant as the Snyder, is not injured as severely, but requires the attention of the grower when the disease does appear. On the Snyder and Kittatinny injury is done on the stems, leaves and fruit, particularly on the latter, it being not uncommon to note as great an infestation as sixty per cent of the fruit. In spring the fungus attacks the current year's growth when the shoots are six inches to one foot in height. It is apparent that the disease spreads from cankers in the canes and that the spread takes place before the canes produce their branches, since these branches and their leaves are free from the disease while the canes and the leaves produced upon them earlier in the season are infested. As soon as the young fruit forms the fungus spreads from the canes, shoots and leaves to the fruit. The disease continues to spread on the fruit until picking time. The damage to the fruit depends upon how many of the drupels of each fruit became infested. The infestation is so great under some conditions that fully fifty per cent of the fruit cannot be marketed as fresh fruit. Lesser degrees of infestation renders the fruit less desirable than clean fruit, since the infested portion becomes dry and woody. The control of the fungus is, therefore, important. The fungus probably lives on the leaves on the ground and in the canes. To check the ravages of the disease it has been proven that the badly infested canes should be cut and burned and the lightly infested and healthy ones sprayed with 4-4-50 bordeaux mixture. One application should be made just before the leaves come out, a second at the time the young shoots are six to twelve inches tall and a third just before the blossoms appear.

Root rot is very largely confined to raspberries, among which the Antwerp suffers most. This rot is caused by a toadstool. The threads, of which the vegetable portion of the fungus consists, live in the soil or in vegetable matter, either living or dead. Under some conditions these threads may be enclosed in large cord-like strands which are known as the "shoestring fungus." These "shoestrings" attach themselves to the crown and roots of plants. Some of the threads work their way into the plant with the result that the plant becomes badly injured, and sooner or later succumbs to the action of the fungus. The death of the plants may occur in the rows or over larger or smaller areas, a few of which areas may be more or less circular, the disease being spread from a central point of infection. The presence of the fungus in the field is sometimes located, and especially in autumn following the early rains, by a few or groups of brown mushrooms alongside or attached to the crowns of the plants. After plants have become diseased the

only logical practice is to remove the plants at once after the crop of fruit has been gathered. All portions of the plants should be gathered and destroyed by burning. The ground from which they were taken should be plowed deeply and left rough so that the soil will weather as much as possible before the following spring. Cultivated crops grown and given the proper cultivation for a period of two seasons is supposed to fit the ground for replanting to raspberries if one so desires. In locations where the plants stand in soil which is flooded for a few days or is extremely wet during the winter, a second root rot occurs. This disease is caused by a fungus, one of the imperfect forms, which is fully as destructive as the toadstool. It is not uncommon to find this same fungus killing plants standing in very rich soils.

Cane blight is a fungous disease of the bark of the raspberry and is largely confined to red varieties. It also occurs on blackberries, but is not considered to be of much importance, since apparently no injury is caused. On the red varieties, however, the action of the fungus is easily noted by examining the bark of infested canes during May and later. The bark on badly infested canes will be more or less loosened from the canes; the epidermis will show a whitish appearance and will contain numerous black specks, the fruiting bodies of this fungus. From these fruiting bodies spores are discharged which, when they locate upon the stems and germinate, produce elongated purple blotches around the lower nodes and buds of the young canes. Early infection of the canes is very readily seen during July and later. When the infestation is severe the plants become stunted, the fruit is small and the yield light. This is one of the severe diseases of red raspberries occurring in the West which has not received the attention it should have received relative to its control. Cane blight of the blackcap is also a fungous disease of the cane, but, as the name indicates, is a disease confined to blackcap varieties. The fungus lives within the canes, apparently gaining an entrance through the roots, after which it works its way upward through the canes and the branches. This fungus is so destructive that the commercial production of blackcaps is pursued with many failures, since the plants which become infested die very quickly. It is not uncommon to see plants dry up within a period of two or three days, even after the berries are beginning to ripen. Ravages of this fungus are so severe that little or no encouragement can be given relative to the growing of the blackcap. Being a disease caused by a fungus living within the soil, and is apparently present in all types of soils, it is not possible at the present time to suggest methods of control that will give results worth the time and expense of doing the work. Badly diseased and dead plants should be dug up and burned at once.

Courtesy of Washington State College
Blackberry Crown Borer in its various stages

Orange rust is by no means uncommon on raspberries and blackberries, but is very largely confined to the Antwerp raspberry. This disease takes its name from the bright orange masses of spores which appear on the under surface of the leaves. Plants with these spots are known to be infested with the rust fungus, which after its entrance into the plant continues to live within it, producing several kinds of spores, most conspicuous among which are the orange-colored ones. Infection of the plants takes place through spore forms. Since the mycelium or vegetative portion of the fungus is well scattered through the plants themselves, the only method of eradicating the disease is to destroy the plants. This should be done by digging and burning every part of the diseased plants. When the work is done great care should be taken to do complete work, as a single source of infection will suffice to cause havoc in the new plants and clean fields.

Courtesy of Washington State College
Blackberry Crown Borer
Two canes with empty pupa cases; two canes tunneled by borer.

Leaf spot is a disease of red raspberries and the Lucretia dewberries. It puts in an appearance in the blades of the leaves early in summer and does more or less damage before the close of the growing season, depending on the number of infestations which take place early during the season. The disease is quite characteristic, since the brown areas are small and irregular in shape, being bounded by the branches forming the frame and network of the leaf. Within these brown areas the fungus produces masses of spores located in small postule-like bodies enclosed within the leaf. A thorough application of 4-4-50 bordeaux mixture on the leaves before the spots begin to appear controls this trouble.

Yellows is a trouble which sometimes becomes conspicuous on some plants, either standing alone or in groups. An examination of the leaves shows that the blades become crinkled and streaked with yellow between the ribs and large veins. Later these yellow areas widen and the central portions become brown. When the trouble is very marked the leaves become brown throughout and drop off before the close of the growing season. This trouble is associated with poor drainage, poor fertility of the soil, poor mechanical condition of the soil, all forms of root rots, and occasionally accompanies diseases of the stem. The trouble is very marked on plants of black raspberries infested with the cane blight fungus.

Fruit rot, a disease of all varieties of raspberries and particularly injurious on the Cuthbert and Antwerp, became very destructive two years ago throughout portions of the Puget Sound country. This disease is of fungous origin and is caused by an imperfect form. From a field study and a limited amount of laboratory work of the fungus and pure cultures, it was found that the fungus apparently gains an entrance into the fruit through the tip of the pistil. After infection takes place the fungus gradually encroaches upon the fruit until the entire berry is filled with the fungus and becoming a lead color. It was apparent that one to several infestations do take place on the same fruit. One is sufficient, however, to destroy a fruit. This fungus has not been investigated far enough to

Continued on page 51

Important Diseases of Small Fruits in the Pacific Northwest

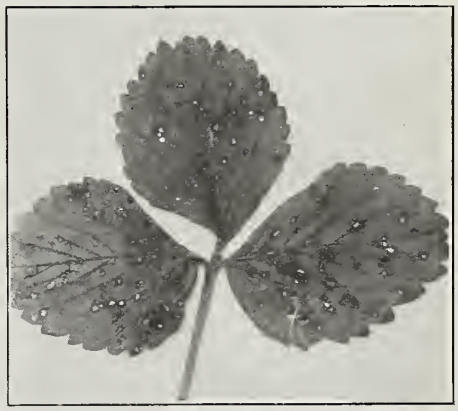
By H. S. Jackson, Plant Pathologist, Oregon Agricultural College, Corvallis

THE increased interest which has been so rapidly developed during the past few years in the cultivation of small fruits in the Northwest has brought with it an increased demand for information regarding the diseases of these crops. Unfortunately the development of the industry, as is usually the case, has been more rapid than the progress of investigation of these diseases. Observations made by the writer during the past three years indicate that there are a number of troubles, some of them causing serious losses to small fruits which have not yet been thoroughly studied by pathologists. Some of these troubles will require careful, thorough investigation before recommendations can be safely made to growers. Others are fairly well known, mainly, however, by investigation carried on in other sections of the country. The following account has been prepared with the object in view of acquainting the growers of small fruits in the Northwest with the most common diseases and the remedies recommended. Each disease has been taken up independently of the others and an effort has been made to present the most important facts regarding symptoms, cause and control in untechnical language. No effort has been made to include all of the diseases known to occur in the Northwest. Only the most important ones, concerning which definite knowledge of cause and treatment is available are included.

Anthracnose of Raspberry, Blackberry, etc.—The disease known as anthracnose is a very common trouble of certain varieties of blackberries and raspberries throughout the United States, and in Oregon at least the disease is becoming serious upon the Loganberry as well. This is apparently an American disease first described by Burrill, in Illinois, about 1882, and has been referred to many times as causing considerable loss in various sections of the country. It is probably the most serious disease with which the Loganberry grower is likely to have to deal, and in most sections spraying for this disease will doubtless become a regular operation in connection with the culture of this fruit. The disease attacks the canes, leaves, and according to Lawrence, the fruit. On the stems the disease produces spots of varying size and color, depending upon the variety attacked. The spots are pale in the center with irregular brown and black (or on the raspberry particularly purple) margins. The spots may run together, forming long, irregular patches of diseased tissue; on the leaves small spots are produced with pale centers, but with rather broad, reddish or purple borders. On some varieties the diseased area may drop out and give more or less of a shot-hole effect. On the fruits the drupelets are found to be affected, the fungus spotting the individual drupelets. These may be attacked when about half ripe or later. The disease on the fruit is particularly serious on the Snyder blackberry.

Cause.—This disease is due to a fungus (Gloeosporium venetum) which, growing in the tissues of the plant, produces the spotting described above. The fungus reproduces in the spots by the formation of many minute spores in similar manner to that described for apple-tree anthracnose. These spores are disseminated most abundantly by wind and rain. Under favorable conditions spores are produced in great numbers and the disease may spread rapidly over the field. No winter stage has been recorded for this fungus, and it is probable that the summer spore stage may live over on the dead leaves or canes, or in the spots on the wilting canes.

Prevention.—Experience has shown that proper precaution in regard to sanitation has a very important bearing upon the control of this disease. All fruiting canes should be removed as early as practicable after the fruit is picked. These should be removed from the field and burned, preferably before all leaves fall. In trimming out the patch in the fall one should also prune out any seriously affected canes of the current year's growth. There seems to be considerable difference in the susceptibility of varieties to this disease, and where possible resistant varieties should be grown. The experience of



Strawberry Leaf Spot

investigators regarding spraying for this disease has not been uniformly successful, but it seems probable from experiments conducted by Lawrence that three sprayings in the spring will go far toward controlling this disease in the Northwest. Bordeaux mixture should be used in the 4-4-50 or 5-5-50 formula. Spray, first, before the leaves appear in the spring, covering the canes thoroughly; spray again as soon as the leaves are well out and the young shoots are about six inches in height; a third application should be made just before the plants blossom. Where the disease is particularly serious and spring spraying has not been entirely successful, an application about the first of September, before the fall rains begin, might prove advisable, since it would doubtless prevent a large part of the infection which occurs upon the canes in the fall.

Crown Gall.—The disease known as crown gall or root knot is a common one on a large number of trees and small fruits, as well as upon many herbaceous plants. It is known as a particularly severe disease upon certain tree and small fruits. The disease has been reported from most sections of the world where these crops are grown. On the cane fruits crown gall is known to be particularly serious as a disease of the raspberry, certain varieties of blackberries, and has very recently come to be known as a serious disease of the loganberry. While no disease has received more attention in recent years from pathologists than the crown gall, there has been little written regarding the special relation of this disease

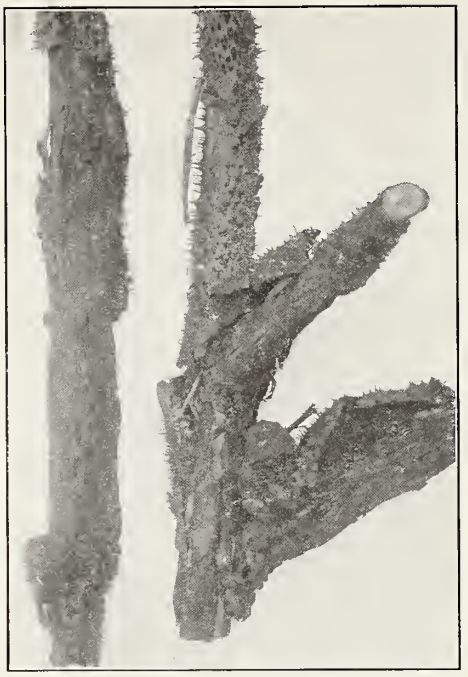
Crown Gall on Roots of Loganberry

to the cane fruits. On the raspberry it is known particularly as a disease of the crown or roots. Large or small galls more or less soft may be abundant upon the crowns and roots affecting the general vitality and productiveness of the plants, and in serious cases resulting in their death, or at least rendering them unprofitable as a commercial crop. The disease seems to be capable of living over for some time in the soil. On the blackberry the disease may also attack the crown and roots. Lawrence has described a peculiar type in which the galled tissue apparently bursts forth from the interior. This form may possibly be a case of the formation of secondary tumors from a primary infection at the base of the plant, though this has not yet been proven. On the Loganberry the disease at the present time has been observed only on the crown or roots, where large swellings may be formed. While no extensive observations have been made as to the severity of crown gall upon Loganberries, from what is known of the effect upon other cane fruits it is to be expected that the Loganberry will be seriously injured when diseased. Since crown gall is so widespread a trouble, it is probable that this disease may ultimately be one of the most serious pests to Loganberry growers.

Cause.—For a long time the cause of crown gall was unknown, but in recent years Dr. Smith has proven beyond doubt that the disease is due to a species of bacterium which is known as Bacterium Tumefaciens. The disease is known to be contagious and has been transferred from galls of peach to those of red raspberry; from red raspberry to grape, and from raspberry to peach.

Treatment.—No remedy for the treatment of diseased plants is known. It is probable that all attempts to control the disease must be by preventive measures. There is considerable difference in the susceptibility of varieties, though there have been very few observations as to these points in the Northwest. Among blackberry varieties, Lawrence states that the Snyder, Kittatinny and Himalaya Giant are severely attacked, while the Era and Early Harvest are only slightly susceptible. Plants evidently diseased should never be planted. Whenever plants are found diseased in a field they should be destroyed by burning. Plants for new settings should be procured if possible from fields known to be free from the disease. It would be inadvisable to plant any other small or tree fruit on ground where this disease had previously been serious on cane fruits.

Mushroom Root Rot.—The same trouble which has attracted so much attention as a disease of apples and prunes in some sections of the Northwest is also known as a disease of cane fruits. This disease, known commonly as the mushroom root rot, has been reported as a serious trouble to cane fruits only in the Northwest. The exact distribution or extent of the disease is not known. No very thorough study of the disease has ever been made with special reference to small fruits, though Lawrence records some interesting observations. The general effect upon the plant is to cause a root rot which usually develops first at the crown, slowly killing the plants and gradually causing their death; plants slightly affected show a general yellowing of the foliage, together with failure to make proper growth. Plants may die at any season of the year. Whenever any trouble of this sort is observed upon cane fruits an examination should be made of the crowns and roots. If the disease is mushroom root rot usually an abundance of shining black strands about the size of an ordinary pencil lead will be found twining about the surfaces of the affected bark of the roots or crowns. These are the so-called rhizomorphic strands of the fungus technically known as Armillaria Mellea. In the fall, where the disease is present, the fruit bodies of the mushroom may frequently be found about the bases of affected plants. These are quite variable and are generally yellowish or brownish in color with a rough cap. The gill-like structures on the under side of the cap are attached to the stem, and toward the upper part of the stem is found a definite ring. On the surface of the plate-like gills countless minute spores or reproductive cells are produced which may be disseminated by the wind and thus spread the disease. The disease may also be spread by the growth of the rhizomorphic strands in the ground from one plant to another. The disease may spread in this way in a field, killing out large numbers of plants. It is also probable that the disease may be spread in the row by bits of the rhizomorphic strands being carried from one point to another on the tools used in cultivation.



Crown Gall on Canes of Mammoth Blackberry

Anthracnose on Loganberry Leaves

Treatment.—On account of the nature of this disease it is a very difficult one to combat. When a plant is once diseased no remedy is available. Such plants should always be destroyed immediately, together with any others in the vicinity which seem to be partially diseased. It would not be advisable to replant where plants have been killed out until a period of at least three years has elapsed, during which time some other cultivated crop, not susceptible to disease, has been grown. Wherever the toadstools are found they should be destroyed at once by burning. Every care should be taken that wounding of the plants at the crowns or below be avoided, since any method by which the plants may be wounded would doubtless increase danger from attack of this disease. This disease needs careful study, as most of the information available at the present time is merely the result of observations rather than of exhaustive study. It is quite evident that there are other serious root troubles of cane fruits present in the Northwest which have not yet been investigated. These are often confused with the mushroom root rot caused by Armillaria Mellea, described above.

Raspberry Cane Blight.—The cane blight is a serious disease of the black and red raspberry and is known to attack other berries as well. It was first described as a serious disease by Stewart of the State Experiment Station of New York. Since that time it has been reported in a number of sections of the country. It is reported as causing serious damage in Southern Oregon, and no doubt occurs in other parts of the state, though complaints from growers have not been frequent. The disease is characterized by a wilting of affected canes. It is most common as a disease of the fruiting canes, though young ones may be attacked. The entire cane may be wilted or only a part of it. If closely examined a diseased area of tissue will be found at the base of the wilted portion. The bark of diseased canes is lighter in color than is normally the case. The disease commonly starts in stubs exposed by pruning. It is probable that most of the infection occurs in wounds.

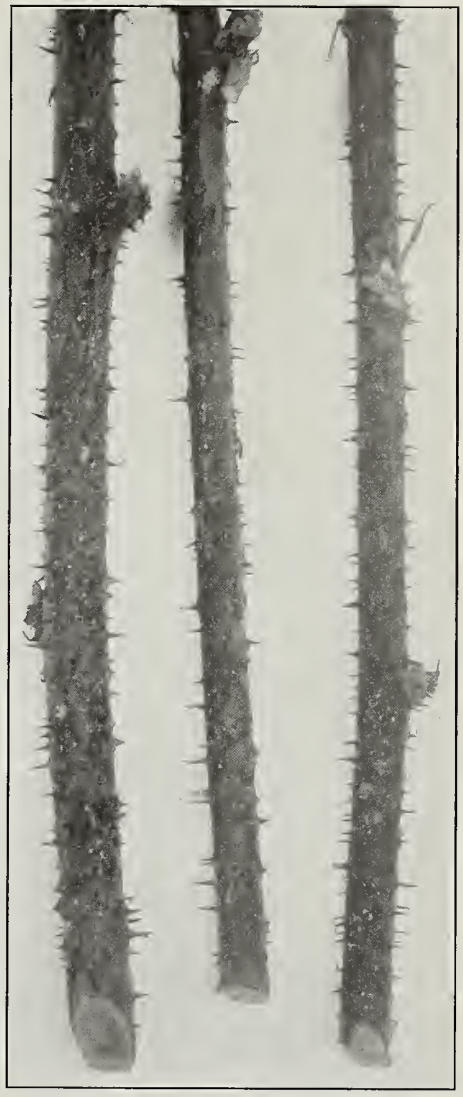
Crown Gall of Grape

Cause.—The disease is caused by a fungus known as Coniothyrium Fuckelii. This fungus grows in the tissues of the stems and causes the death of the tissues and the consequent wilting of the canes. The reproductive bodies or spores are borne in minute receptacles in the discolored areas found at the base of wilted canes or portions of canes. The surface of the bark is often smoky black, due to an abundant production of spores. The disease doubtless lives over winter on old canes or pieces of canes left in the field, and probably on the bases of old canes after pruning.

Control.—The disease is doubtless disseminated through nursery stock, and the purchase of stock for planting from diseased plantations should be avoided. Every effort should be made to obtain healthy stock for planting and new plantations should not be put out where berries have been grown at all recently, since it is probable that the disease may remain in the soil on old pieces of canes for a considerable period. Most careful sanitary measures must be practiced in the field. The old canes or diseased young canes should be removed and promptly burned immediately after picking is over. Old and diseased canes should be cut close to the ground. Where serious, a dormant spray should be given. Use bordeaux mixture 6-6-50, to which has been added a resin sticker. It has also been recommended to spray twice with the same mixture when the plants are in foliage. The first application should be made when the young canes are six to eight inches in height, the second just before the blooming period. Finally an application should be made in late summer, just after the old canes have been cleaned out.

Powdery Mildew of the Gooseberry. This is the most serious fungous disease of the gooseberry which is known to attack the foliage and fruit. It is a native disease, that is, due to a fungus which doubtless occurred upon wild gooseberries before cultivated varieties were planted in this country. It is found to be much more serious upon European varieties than American varieties. It is probable that varieties derived from American species of gooseberries have developed more or less natural immunity to this disease, but varieties originating from European species, not having this fungus to contend with in their native habitat, have never developed any such natural immunity. This disease is present in more or less severity in all parts of the United States where gooseberries are grown. It was introduced into Europe about 1900 and has spread rapidly, and has become so serious that in some localities the growing of gooseberries has been temporarily abandoned. This disease is characterized by the production of a superficial white mold or mildew in spots on the fruit and foliage of young canes. It probably first starts upon the young foliage, but is first noticed by the grower upon the fruit. The spots are at first whitish, but later become buff or almost brown in color. From the fruit it spreads rapidly to the foliage and young canes. If examined with a pocket lens, the spots when young are seen to consist of a white cobwebby growth. Several spots may grow together and large patches may be formed, and in older patches the mouldy growth turns brown. Later in the year small black specks, just visible to the unaided eye, appear in the brown mould in older spots. The berries when attacked on one side may develop unevenly, and in severe cases may crack and decay. When attacked at a later stage they do not crack, but the presence of the mould renders them unsalable. The leaves of diseased shoots are small, and where badly affected gradually turn brown. The general effect on the plant is to reduce the vitality and market value of the crop.

Cause.—This disease is caused by a fungus belonging to a group known commonly as the powdery mildews. These fungi are superficial in their growth, that is, the mycelium develops largely on the outside of the affected



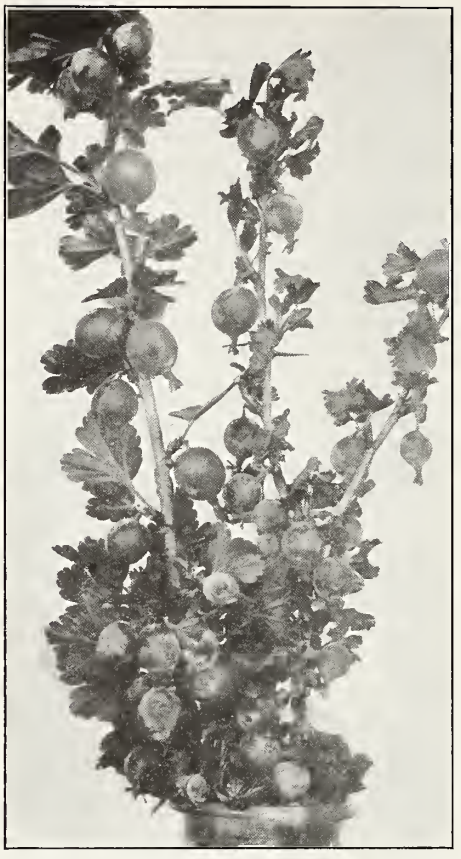
Anthracnose on Canes of Loganberry

spots, instead of in the tissues, as is usually the case. The mycelium sends short branches into the outer cells of the part of the plant attacked. These absorb the sap. In the early part of the season the summer spores are produced in chains on the erect branches of the mycelium. These are produced in great abundance and soon fall apart, giving the surface of the spots a dusty appearance, from which fact the name "powdery mildew" has originated. These spores are easily spread by the wind or in any manner in which they may be carried, and start new spots wherever they come to rest. This superficial mycelium, as noted above, soon turns dark and becomes thick-walled, and later in the season black spherical receptacles are formed which have long threadlike appendages attached. These are called perithecia and are hollow and enclose a single large sack or ascus, inside of which are found eight rather large spores. This stage, which may be referred to as the winter spore stage, serves to carry the fungus over winter. The perithecia, when mature in the spring, burst, setting free the spores, which are ejected forcibly, and coming to rest upon young leaves or fruit, germinate and cause the first spots. It is thus

seen that the fungus which remains over the winter on the canes of the current growth and on the leaves and ground serves as a source of infection in the spring.

Treatment.—This disease is one of the most difficult of the powdery mildews to control. The standard remedy for years has been to spray with potassium sulphide, one ounce to two or three gallons of water, beginning when the buds break open and continuing at intervals of ten days until about seven applications have been made. This has been found to control mildew wherever used thoroughly. Co-operative experiments conducted in Oregon during the past season by the writer indicate that an application of lime-sulphur to the dormant branches, followed by applications of lime-sulphur 1-30 on the foliage at frequent intervals, gives excellent satisfaction. On account of the slight deposit of lime-sulphur it may be found desirable to use potassium sulphide for the later sprayings.

Anthracnose of the Currant.—Currant anthracnose seems to be the most common fungous disease of this fruit which occurs in Oregon. It seems to be widely distributed in the state and is generally known throughout the United States. It is also a common disease in Europe. This disease is also known to attack the gooseberry, but usually not in a serious form, and has not yet been observed upon this crop in Oregon. It is more severe upon the red and white currants than upon the black. There is doubtless considerable difference in the susceptibility of the varieties, but no data of value has yet been brought together on this point relating especially to conditions in the Northwest. The disease is primarily a leaf disease, though it may grow upon practically all parts of the plant above ground, including the fruit. On the leaf the disease causes small brown spots which are more or less thickly scattered. When abundant the affected leaves turn yellow and fall. This disease is probably the cause of much of the premature defoliation of the currant which occurs in the state. The general effect of the fungus is to interfere with the proper development of the fruit and to generally reduce the vitality of the plants and so interfere with the proper ripening of the fruit and the formation of the fruit buds for the next year. Spots of the disease may also occur upon the petioles and young canes and upon the fruit stalks and young fruits. On the leaf stalks and petioles conspicuous black spots which are slightly sunken are formed and similar spots also occur upon fruit stems. Here the spots are black and from one-quarter to one-half inch long. On the fruit black spots resembling flyspecks are formed. On the young canes the disease produces only a slight discoloration and is very difficult to detect, and occurs only upon young canes of the current year's growth. Where plants are in partial shade they are not as seriously attacked by this disease. Older plantations are found to be more seriously affected than more recent plantings.



Mildew on Gooseberries

Cause.—This disease is caused by a fungus known technically as Pseudopeziza Ribis. The fungus exists in two spore stages. In the spots on the leaves, petioles and canes, the summer spores are produced in peculiar fruiting structures known as ascervulæ. These spores are doubtless disseminated by wind and spattering rain, and when coming to rest upon any part of the plant grow into the tissues and cause new spots. This spore stage is called the conidial or summer spore stage. On the diseased leaves which fall to the ground in the fall another spore stage of the fungus is formed. This is produced from the mycelium of the summer spore stage, which spreads in the dead leaves, but is of quite a different character. Little cushionlike fruit bodies are produced inside the tissues of the leaf, which finally break out upon the surface. These are visible to the unaided eye. The surface of these cushionlike bodies when mature is covered by a layer of sacks called asci, each of which bears eight spores. These mature about the time the plants leaf out in the spring. Spores are ejected from the asci and are carried by the wind to the young leaves of currant plants and cause the first spots of this disease which appear in the spring. This fungus is particularly interesting on account of the fact that the life history and structure of the fungus show that it is very closely related to the one which causes the disease known as apple tree anthracnose. It has been proven also that the summer spore stage matures on the stems, and it is possible that the fungus winters over on the canes in the summer stage.

Crown Gall on Stems of Loganberry

Treatment.—Since the first infection results from the dissemination of the sexual spores from the dead leaves of the previous season, any method of destroying these leaves might tend to reduce the seriousness of the attack. It would, therefore, be advisable to plow early, before the leaves come out in the spring, in order to bury the dead leaves. Where practical, raking and burning the dead leaves would have the same result and would probably be more effective. A dormant spraying toward spring to prevent any further development of the summer spores on the canes would be advisable. Use the bordeaux mixture, 5-5-50. Spray again when the leaves unfold, and repeat at intervals of ten days until the fruit is two-thirds grown, avoiding the blossoming period. If summer rains are abundant it may be found profitable to spray once or twice after the fruit is gathered.

Leaf Spot of the Strawberry.—The only fungous disease of the strawberry occurring in Oregon that has been thoroughly studied by pathologists is the disease known as the strawberry leaf spot or blight. This disease is nearly always present to greater or less extent in every field. It is not always serious and in fact is rarely considered by Oregon growers to cause sufficient damage to need special treatment. In many cases, however, it causes more damage than is realized, and hence is considered of sufficient interest to warrant a discussion in this connection. All of the cultivated varieties may be attacked, though many are so resistant

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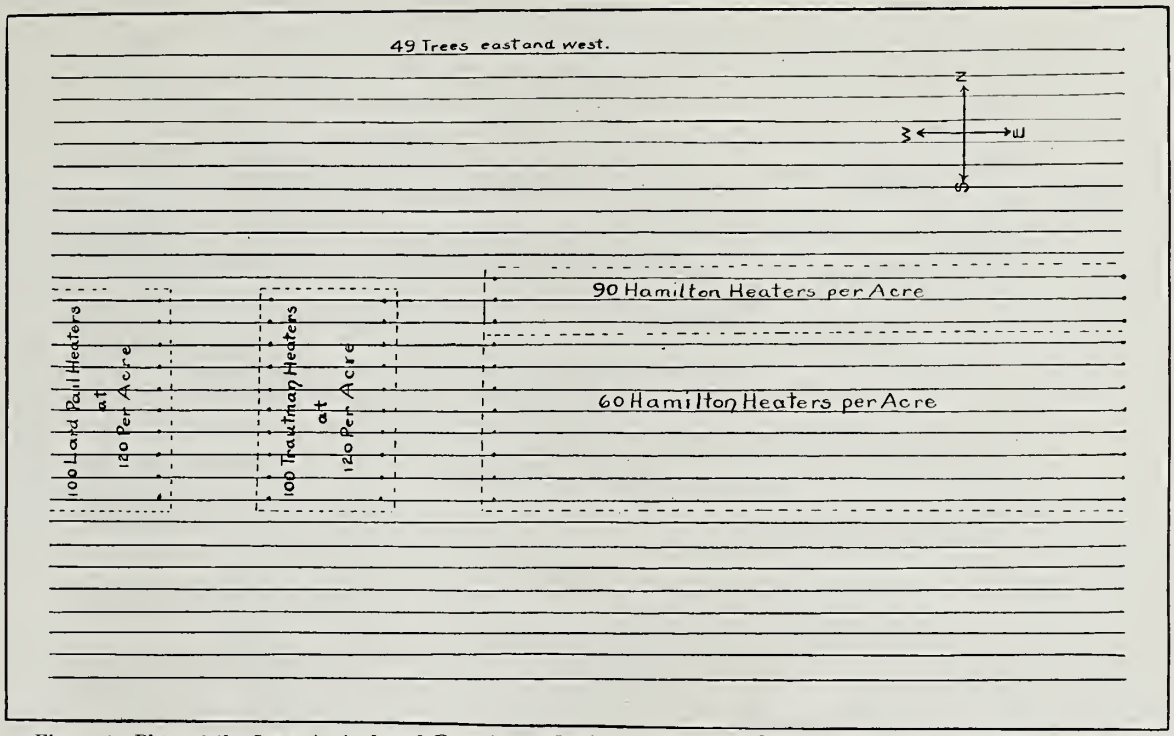

Figure 1—Plan of the Iowa Agricultural Experiment Station Commercial Orchard near Council Bluffs, showing arrangement of heating equipment in orchard heating test.

Orchard Heating, Etc.

Continued from last issue

By referring to figure 7, which is the record made by a self-recording thermometer in the orchard, it will be noted that the temperature was very high on Friday, Saturday and Sunday before the freeze. On the afternoon of Sunday, April 30, the weather bureau sent out warnings that frost was liable to occur before morning. The temperature at the time was close to 60° and the maximum temperature for the day was 64°. The temperature began falling rapidly about 5 p. m. and continued to fall steadily until 3:30 a. m. On the night of April 30, at 11:12, the wind reached its highest velocity, 36 miles per hour, blowing from the north. The highest velocity on May 1 was 39 miles, from the northwest, between 7 and 8 a. m. Snow fell during the greater portion of the time from 2 a. m. until after sunrise. This made the heating work difficult. The pots were lighted about 3:30 a. m., when the temperature was about 30°. The thermometers had been placed in the orchards as follows: Thermometer No. 1, on an east slope at the north side of the orchard, among the Hamilton pots, at 90 per acre; thermometer No. 2, on an east slope pretty well to the south side of the heated area, among the Hamilton pots, 60 per acre; thermometer No. 3, on a ridge with a slightly east slope, pretty well to the south side of the heated area; thermometer No. 4, under conditions similar to No. 3, except that it was placed at the north side of the heated area, among the Hamilton pots, 90 per acre; thermometers Nos. 5 and 6, on a southwest slope near the center of the heated area; thermometer No. 7, on a southwest slope in lower ground, among Troutman heaters, at 120 per

TABLE I—WEATHER CONDITIONS AT OMAHA, NEBRASKA, MARCH, 1911

Date	Temperature (Degrees Fah.) Max.	Min.	Mean	Precipitation in Inch and Hundredths	Character of Day	Snow on Ground at 7 p. m. Inches
1	41	20	30	0	Clear	0
2	57	27	42	0	Clear	0
3	46	30	38	0	Pt. Cldy	0
4	44	26	35	0	Pt. Cldy	0
5	60	35	48	0	Cloudy	0
6	46	31	38	.28	Cloudy	0
7	52	37	44	.10	Cloudy	0
8	49	41	45	T	Cloudy	0
9	65	39	52	0	Pt. Cldy	0
10	59	43	51	T	Cloudy	0
11	69	40	54	0	Cloudy	0
12	47	32	40	T	Clear	0
13	55	32	44	0	Clear	0
14	69	38	54	0	Clear	0
15	38	15	26	0	Clear	0
16	46	21	34	0	Clear	0
17	46	29	38	0	Pt. Cldy	0
18	50	21	36	0	Clear	0
19	66	34	50	0	Clear	0
20	73	42	58	0	Clear	0
21	76	55	66	.09	Cloudy	0
22	55	34	44	0	Clear	0
23	52	30	41	0	Clear	0
24	63	36	50	0	Clear	0
25	68	47	58	0	Pt. Cldy	0
26	61	24	42	.23	Cloudy	T
27	45	20	32	0	Clear	0
28	36	31	34	T	Cloudy	0
29	51	33	42	T	Pt. Cldy	0
30	43	28	36	.53	Pt. Cldy	1.0
31	37	31	34	.06	Cloudy	1.0
Mean	53.7	32.3	43	1.29—Total		

APRIL, 1911

						Sunshine %
1	37	26	32	.03	Cloudy	0
2	54	33	44	0	Pt. Cldy	66
3	37	32	34	T	Cloudy	0
4	35	33	34	.12	Cloudy	0
5	60	34	47	.54	Cloudy	33
6	40	30	35	0	Clear	76
7	52	32	42	0	Pt. Cldy	72
8	48	32	40	0	Clear	100
9	57	30	44	0	Pt. Cldy	78
10	64	46	55	0	Pt. Cldy	26
11	68	46	57	.13	Pt. Cldy	40
12	72	43	58	.01	Cloudy	22
13	54	38	46	0	Clear	83
14	58	34	46	0	Clear	100
15	63	38	50	0	Clear	100
16	74	41	58	0	Clear	100
17	73	51	62	T	Clear	72
18	63	50	56	.01	Cloudy	10
19	66	42	54	0	Pt. Cldy	62
20	67	46	56	0	Pt. Cldy	40
21	74	47	60	0	Clear	100
22	63	45	54	0	Pt. Cldy	35
23	64	42	53	0	Clear	85
24	64	43	54	0	Clear	81
25	64	44	54	0	Pt. Cldy	46
26	63	49	56	.38	Cloudy	16
27	69	54	62	T	Pt. Cldy	50
28	76	55	66	.65	Pt. Cldy	45
29	78	59	68	.07	Pt. Cldy	71
30	64	40	52	.40	Cloudy	0
Mean	60.7	41.2	51	2.34—Total		

TEMPERATURE

Highest, 76°; date 1st.
Lowest, 15°; date 15th.
Greatest daily range, 37°; date 26th.
Least daily range, 5°; date 28th.
Normal for this month, 23.7.

PRECIPITATION

Total this month, 1.29; snowfall, 6.
Greatest precipitation in 24 hours, .59; date 30th and 31st.
Snow on ground at end of month, 1.

WEATHER

Number of days clear 14, partly cloudy 7, cloudy 10, on which .01 inch or more of precipitation occurred 6.

TEMPERATURE

Highest 78°, lowest 26°; date 1st.
Greatest daily range, 33°; date 16th.
Least daily range, 2°; date 4th.
Normal for this month, 50.5°.
Accumulated excess since January 1, 545°.
Daily average excess since January 1, 4.5°.

PRECIPITATION

Total for this month, 2.34; snowfall, 0.3.
Greatest precipitation in 24 hours, 0.72; date 28th and 29th.
Normal for this month, 3.01.
Deficiency of this month as compared with the normal, 0.67.

WIND

Prevailing direction east.

WEATHER

Number of clear days 10, partly cloudy 12, cloudy 8, on which .01 inch or more of precipitation occurred 10.

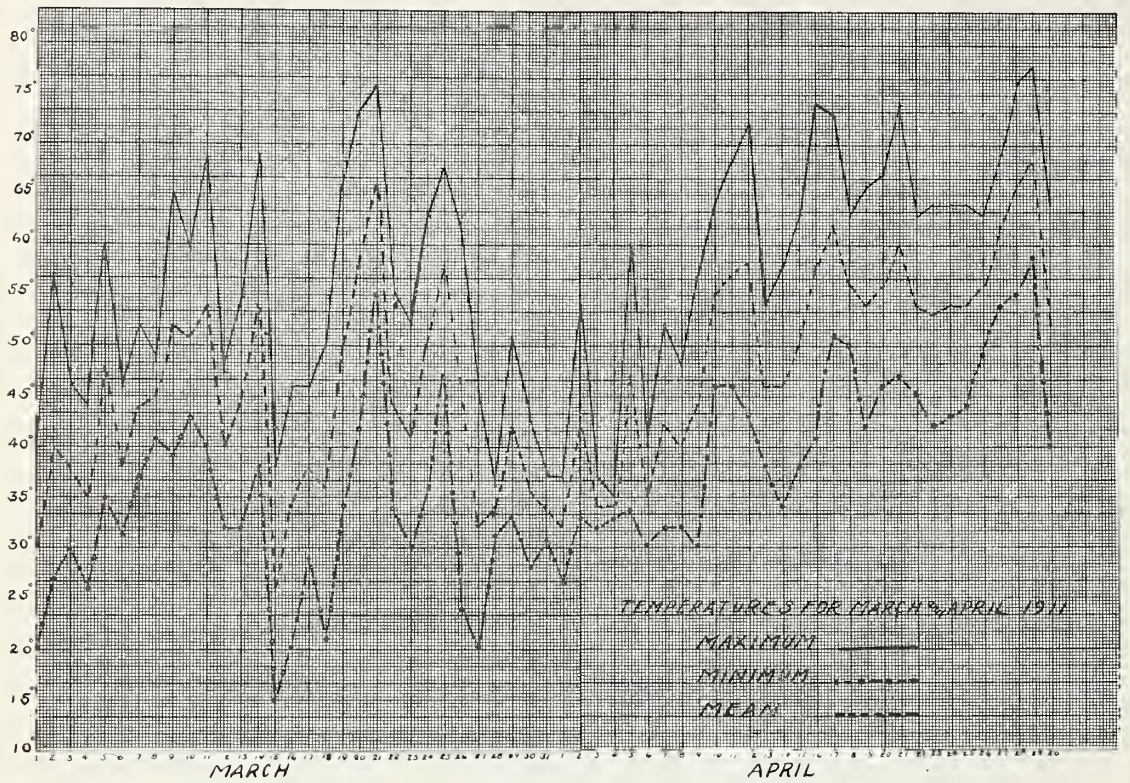

Figure 6—Chart showing range of temperatures at Council Bluffs in March and April, 1911

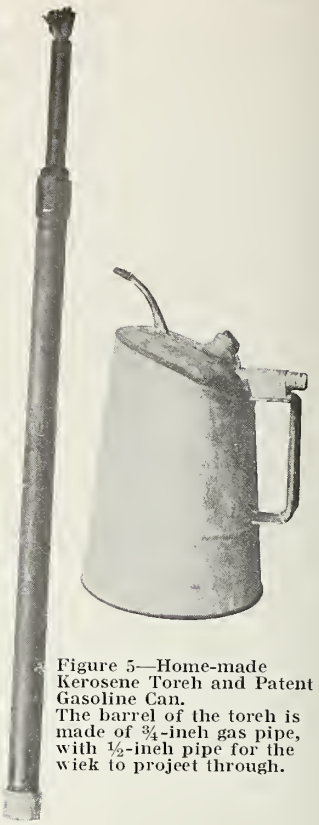

Figure 5—Home-made Kerosene Torch and Patent Gasoline Can. The barrel of the torch is made of ¾-inch gas pipe, with ½-inch pipe for the wick to project through.

aere; thermometer No. 8, on an east slope in low ground, among lard-pail heaters, at 120 per acre; thermometer No. 9, outside the heated area. The temperatures are given below for the two readings which were made at 4:45 a. m. and 5:45 a. m., respectively. It will be noted that at 4:45 a. m. the average rise in temperature was about 2½°, while at 5:45 a. m. the average had dropped to about 1½°.

Number	*4:45 a.m.*	*5:45 a.m.*
1	31½°	31½°
2	33¾°	32¾°
3	33¾°	33¾°
4	31¾°	30¾°
5	33¼°	30¾°
6	33¼°	32¼°
7	31¼°	31¼°
8	31¾°	31¾°
9	30°	30°

While the total capacity of the Hamilton pots was not used at this time, because the temperature was eonstantly above the danger point, it is doubtful whether or not the temperature could have been raised very materially with a thirty-five-mile wind blowing. Even with the pot eovers drawn very slightly most of the oil was consumed in the eourse of three or four hours' burning. A few pots consumed but little oil, owing perhaps to proteetion from the wind, while others had burned out in an hour and a half. Considerable difficulty has been reported with the Hamilton pots blowing up, but no such trouble was noted in the above tests. In all the pots were burned about three hours. At the end of that period most of the lard pail and Troutman heaters had been out for some time, although a few were still smoking. The Hamilton heaters had mostly burned dry, but a few of them had burned less than half of the oil they eontained and were still burning. The experience of April 30 would lead to the belief that orehard heating in Iowa is possible under very extreme eonditions, but would prove very expensive and diffieult with very strong winds at the frost time. That the temperature was materially raised in the heated area was shown by the faet that outside the heated area the ground and trees were thoroughly covered with snow, while inside the heated area, exeept where the snow blew in on the north side, the ground was bare, as were the trees also. This is shown by figures 9 and 10.

On the night of May 1 the second test of the heaters was had, and thermometers were plaeed in the following stations in the orehard: Thermometer No. 1, in the area with 60 Hamilton heaters per acre; this was on rather high ground and pretty well to the south side of the heated area. Thermometer No. 2, in the area with 90 Hamilton heaters per acre, on the north side of the orchard; this was on rather high ground also. Thermometer No. 3, among the Troutman heaters, which were placed at the rate of 120 per acre; this ground was rather low and on a southwest slope. Thermometer No. 4, among the lard-pail heaters, distributed at the rate of 120 per acre; thermometer No. 4 was in the lowest ground and on an east slope. Thermometer No. 5, outside the heated area, on the highest point in the orchard. All of these thermometers were placed about six feet above the soil on the southeast side of the tree. Reading are given in table II.

By referring to the chart of temperatures on the night of May 1, it will be noted that the temperatures fell rather slowly, dropping four degrees from 11 p. m. to 2:30 a. m., or a little more than one degree per hour. When temperatures are dropping at such a rate it is not neeessary to fire up much before the danger point is reached. The heaters were not lighted on this night until the temperature had reaehed the recorded danger point. This was somewhat hazardous, but elose wateh was kept and plenty of help was at hand to light the heaters quiekly. Another reason for the delayed lighting was to test the possibility of raising the temperature after it had fallen to or below the danger point. It is better to hold the temperature at 30° or 32°, even on such a night, than to try to raise it. The temperature records show that the Hamilton heaters, opened to about two or three inehes, held the temperatures about 1½° higher than outside the heated area, but when opened to four or five inehes the temperatures were raised from 3½° to 5½°. The advantage of some device for keeping the burning surfaee as high late in the night as it is at the beginning of the heating period is shown by this reeord. The smaller pots were satisfaetory on this night, as the frost period was short, but where the wind is blowing or the frost period is long the smaller heaters would have to be

TABLE II—TEMPERATURE RECORD NIGHT OF MAY 1, 1911

Location	*2:30 a.m.*	*3:15 a.m*	*4:00 a.m.*	*5:00 a.m.*
Thermometer No. 1—Hamilton Heaters, 90 per aere	29¾°	31¼°	31¼°	36¾°
Thermometer No. 2—Hamilton Heaters, 60 per aere	29¼°	31½°	30¾°	34¾°
Thermometer No. 3—Troutman Heaters, 120 per aere	28¾°	32¾°	32¾°	....
Thermometer No. 4—Lard-Pail Heaters, 120 per aere	28¾°	34¼°	32°	....
Thermometer No. 5—Outside heated area	29°	28°	26½°	26½°

Heaters were lighted between 2:30 and 3:15 a. m. At 4 a. m. the temperatures were falling outside the heated area, and to prevent a corresponding fall inside the heated area the eovers of the Hamilton Heaters were drawn from 2½ inehes where they had been burning to 4 or 5 inehes, with the resulting rise of temperature indieated. No more reeords were taken, as the temperature soon began to rise outside the heated area and there was hut little ehange in the thermometer readings.

Figure 2—Storage Tank on Orchard Hillside. With a pipe line down the slope filling the distributing tank becomes an easy task.

refilled or a reserve supply provided. The recorded tests would indicate that when the air is still from five to ten degrees of frost could be successfully fought for a few hours. A great difference was noted in the amount of oil consumed on the night of April 30, when a high wind was blowing, and on the night of May 1, which was comparatively still and clear. The first night from two to three gallons were consumed in practically all of the large pots, many of them burning dry in two to three and one-half hours. On the night of May 1 very little over one gallon was consumed in the same length of time. There seemed to be considerable difference in the amount of oil consumed in different pots. This variation was probably due to differences in protection and to the fact that the covers were not carefully placed and that a better draft resulted in some cases than in others.

The practicability of heating small orchards is often questioned. It is comparatively much easier to heat a large area than a small one. But there are many home orchards, both on farms and on city lots, where oftentimes the fruit is more highly prized than it would be in a commercial orchard. Two experiments were planned to test the possibilities of heating these small areas. The first was carried on in a small orchard belonging to D. L. Royer of Council Bluffs, located about 80 rods north of the station's experiment orchard. The trees stand on very nearly level ground which is much higher than surrounding areas. The orchard lies some distance from a timbered tract, but as the test was made on a comparatively still night the effect of this timbered area would be slight. Fifty Hamilton heaters were distributed at 40 per acre in this orchard. The lighting was done somewhat later than in the larger orchard and less accurate records were obtained. The readings were made at irregular intervals and the average rise in temperature was from 27° to 32°. It is doubtful if as favorable results could be secured on a windy night unless the orchard were well protected by a wind-break and a larger amount of oil were consumed. The second of these tests was in a block of trees in the orchard of E. H. Graves, Ames, Iowa. The plot selected was on the east side of the orchard, and while some wind protection was afforded by the trees to the north and west of the heated area, this protection could not seriously affect the results obtained. This test was made under the direction of J. H. Allison, foreman for the horticultural department, while most of the work was done by horticultural students.

One hundred Hamilton heaters were distributed at the rate of 75 per acre, or one to each tree, making the heated area about one and one-fourth acres in extent. A double row of heaters was placed on the north side of the block. The pots were filled with buckets from oil barrels, it being necessary to purchase oil in barrels where small amounts are used. A cheap grade of illuminating oil may often be purchased of the local oil company. Fuel oil in barrels costs about six cents per gallon. Sunday afternoon, April 30, word of an approaching cold wave was received at Ames. The horticultural students were at once notified, and at 6:30 p. m., after a very hard shower, they drove out to the orchard. The temperature at 7:30 p. m. was 57°, with a hard, driving rain from the northeast. Hard showers of rain continued at intervals throughout the night, turning to snow about 5:30 a. m. Monday. The temperature reached only 32° and no heaters were lighted. On Monday night, May 1, temperature readings were taken each hour, which ranged as follows: 7:30 37°, 8 35°, 9 34°, 10 32°, 11 31°+, 12 31°, 1 31°, 2 31°, 3 29°.

At 3:15 a. m. the pots were all lighted with the covers drawn six or eight inches. At 4 a. m. the temperature outside the heated area was still at 29°, while that inside was 35°. At this time all the pots, excepting the two west and the two north rows, were closed to two and three inches. At 4:30 a. m. the temperature outside the heated area still remained at 29°, while that inside the heated area had dropped from 35° to 32°, where it remained about uniform until 5:30 a. m. The temperature outside the heated area, however, raised 1° and stood at 30° at 5 a. m. In less than half an hour it was down to 29° again, while the temperature inside the heated area remained at 32°. At 5:30 a. m. the sun was just above the horizon. To find the effect of opening and closing the covers of the Hamilton heaters the covers were drawn about half open at 5:30 a. m., and in fifteen minutes the temperature inside the heated area raised from 32° to 37°. The covers were then closed to two inches, and in another fifteen minutes the temperature dropped to 32° again. The pots were not all full of oil to start with, but in burning from about 3:15 a. m. to 5:30 a. m. many of those on the north and west sides, where they were open six to eight inches, burned dry. For some cause, probably due to water in the oil, several heaters exploded when burned nearly dry.

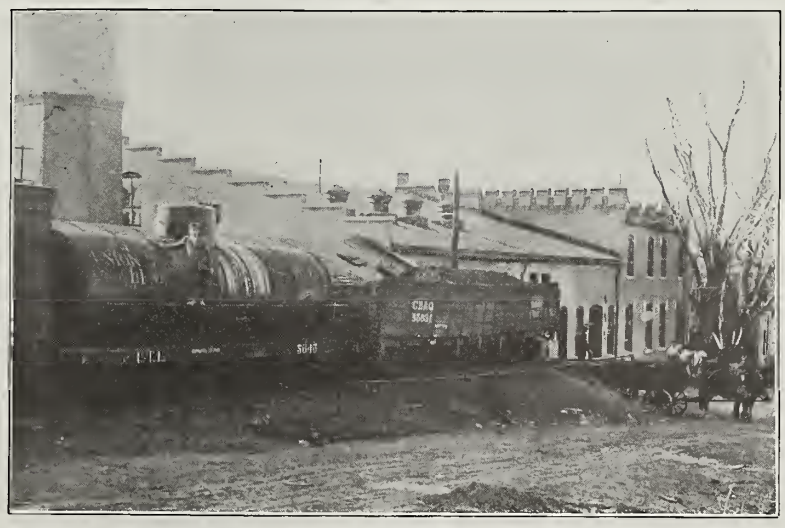

Figure 3—Filling wagon tank from tank car by gravity. Note the line of pipe extending from the car along track bed to the wagon.

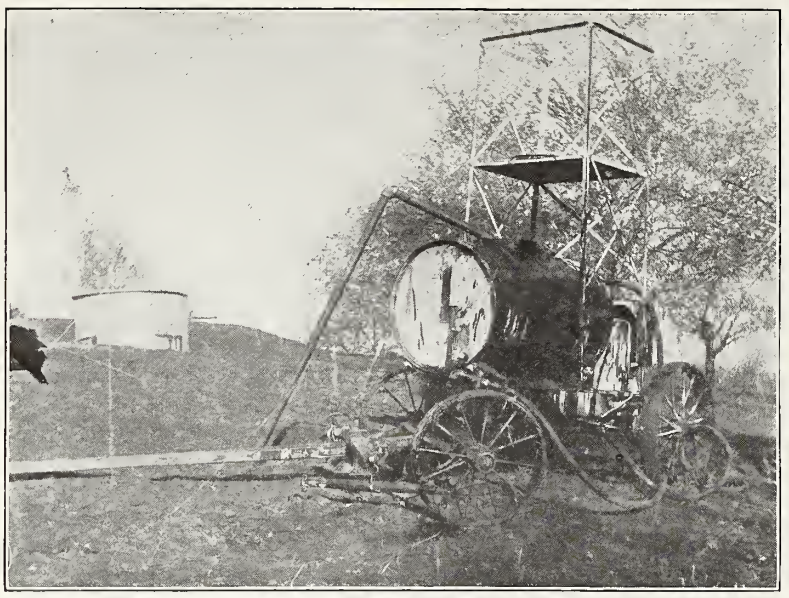

Figure 4—Filling the distributing tank. Note the standpipe from which the oil is running; also the nozzle, for filling heaters, resting on front wheel.

It will be noted that by using 75 heaters per acre the temperature was raised from 3° to 8°, according to the amount of the burning surface of the heaters used. While no accurate record of the amount of oil consumed was kept, yet with the heater covers drawn two to three inches the temperature was raised 3°. With this burning surface each pot would consume about one quart per hour, or a total of 18¾ gallons per acre per hour. This would mean a cost of approximately $1.15 per acre per hour to hold the temperature against three degrees of frost. The heaters used in this experiment are sold at $45 per hundred, and will last a number of years. After the first year's cost of installation the cost of protecting the home orchard will amount to between $1 and $2 per acre per hour. No estimate of the cost of labor or oil storage is given, as the owners of small tracts can easily handle the equipment without extra labor. The oil will come in barrels and can be distributed from these, so that no storage is necessary. Where the fruit is highly prized this expense will not be prohibitive, and under ordinary conditions the fruit can be saved on small areas. Wind-breaks will be found especially valuable in protecting small areas during high winds.

Several Iowa orchardists used heaters during the spring of 1911. They were asked to fill out blanks, giving the results of their work, and the following notes are taken from the reports of each:

C. H. Deur, Missouri Valley, Iowa—Mr. Deur heated five acres of orchard, 13-year-old trees. The trees were 24 feet apart and of fairly good size. He used 70 three-gallon Hamilton heaters per acre, placing one to each tree and about 12 feet from the tree. The orchard is on a north slope and is somewhat higher than the valleys nearby, but there are a number of higher hills surrounding the orchard. Mr. Deur fired his heaters at a temperature of 38°, lighting his heaters by using a wick of dry grass and a torch made of a ball of twine soaked in oil. The temperature outside the heated area dropped to 28°, and the lowest temperature inside was 32° and the highest 38°. The average rise of temperature was 6°. This heating was done on the night of May 1, when there was practically no wind and the sky was clear. Mr. Deur kept his fires going from 9 p. m. until 6 a. m. and estimates that he used about 200 gallons of oil per acre. It would appear from this statement that the Hamilton heaters consumed three gallons of oil per heater in nine hours, but Mr. Deur does not state what burning surface he used. His oil was the 40 gravity distillate put out by the Standard Oil Company. The blossoms were just beginning to open May 1, and there was apparently no injury May 20, when he sent in his report. Mr. Deur states that he considers orchard heating practicable under Iowa conditions and that he will increase his equipment for the season of 1912. He would recommend that 75 to 80 heaters per acre be used rather than a smaller number. He also states that, had the freeze come one week later, he is quite certain that he would have had a small crop of apples outside of the firing zone. He gives the cost of his heaters as 35 cents each f.o.b. Missouri Valley; the cost of oil 4 cents per gallon, in the orchard. He does not give the cost of his storage tank or labor. From the above it is estimated that 200 gallons of oil per acre would cost $8. This is rather high cost per acre, but it would hardly be necessary to fire up at 38°, and in all probability the time of heating could be cut down more than half.

C. O. Garrett, Mitchellville, Iowa—Mr. Garrett heated 15 acres of trees from 6 to 25 years of age and set at varying distances. The heaters were used among plums, cherries and apples. His orchard is on comparatively level ground, though it is higher than the surrounding country. He used 80 to 100 Hamilton "Competition" and Troutman heaters per acre. This would place them at from 21 feet to 23 feet apart each way. Mr. Garrett fired his pots at 31°, using gasoline oil can and a corn cob soaked in kerosene. The lowest temperature outside of the heated area was 31°, while the lowest temperature inside the heated area was 36°. The average rise in temperature was 6°, with a wind velocity estimated at ten miles per hour on a clear night. The heaters burned four hours and consumed 160 quarts of oil, which was the Rayo orchard heating oil put out by the Standard Oil Company. There was no injury apparent, possibly due to the fact that the blossoms were only beginning to show pink. Mr. Garrett states that he believes the heaters will come more and more into use as people become familiar with them, as it seems to be an easy matter to heat an orchard under ordinary conditions. He recommends 100 eight-quart heaters per acre. The cost of his equipment was as follows: Heaters $150, which would mean $10 per acre; oil, in carload lot, 1.4 cent per gallon. (In all probability freight is not included.) No statement is given as to the cost of storage tank and labor, as Mr. Garrett did most of the work himself and kept no track of time. Mr. Garrett makes the following observation: "The apple buds were not out far enough to be injured by such a moderate temperature. Plum and cherry and pear were in full bloom, and while I do not think there was any injury it demonstrated to my own satisfaction that the heaters will do the work under ordinary conditions, as I only used one-half the number of pots in the orchard and raised the temperature five to six degrees. My trouble was from leaking pots, which I could not use, and lost quite a quantity of oil; this owing to faulty construction."

Continued in next issue

Monument to An Apple Tree

Recently, at the little town of Dundela, near Morrisburg, Ontario, a monument was unveiled to the original McIntosh red apple tree. This tree was discovered by John McIntosh over 115 years ago while clearing a place for a home. He found several apple trees, but one of them which grew a superior quality of fruit he named the McIntosh Red. This fruit drew such wide attention that his son, Allen, propagated and disseminated it until now it is grown and planted in all parts of the continent. In 1896 one side of the tree was destroyed by fire, but the other continued to bear fruit until 1908, when the tree died.

Williams Bog at Ilwaco, Pacific County, Washington, Planted May, 1912, With Vines From Massachusetts
This bog is constructed in accordance with the best modern practice. It contains about twenty acres of prepared bog and several hundred acres of raw land, considerable of which is now being prepared

Cranberry Culture on the Pacific Coast

By C. N. Bennett, Civil Engineer Clatsop Cranberry Bogs, Warrenton, Oregon

CRANBERRY culture on the Pacific Coast at the present time is a very small industry, but within the next few years will probably be of considerable importance. While it is a small and comparatively new industry on this Coast it is by no means an experiment, as bogs were established on this Coast about twenty-five years ago. One bog with an area of about five acres was established in Coos County by Mr. McFarland; it is still producing and has proven very profitable to the owners. Another bog of about fifty acres was established in Pacific County, Washington, by Mr. Chebot; for a number of years it proved profitable, but after the death of the original owner it was neglected and at present is in poor condition. It is still producing, but both the quality and yield of the berries are poor. The present owners, however, intend to replant this bog in accordance with the best modern practice. Cranberries are now grown commercially all along the Pacific Coast from Coos Bay to Puget Sound, although the bogs are mostly of small area and there are few of them that are properly cared for.

There are probably not over 80 or 100 acres of bearing bogs on the Pacific Coast, the greater part of which is in poor condition, and these bogs probably do not yield over 2,000 barrels annually. There is probably about 15 acres of bearing bog in Oregon, all of which is located principally in Coos and Tillamook Counties. The largest acreage of bearing bog is in Pacific County, Washington, where there is probably about 65 acres, a great part of which is in poor condition and the yield is light. A few of the smaller bogs are well cared for and produce good crops. There are a few small bogs located in Washington, north of Pacific County, but the acreage and production is small.

There is probably in the neighborhood of 125 acres of vines, which have been planted within the last year or two, and are not yet in bearing, the greater part of which is in Pacific County, Washington. In Oregon there is about 20 acres scattered along the coast. In Clatsop County, Oregon, where there has never been any cultivated bogs, there is now about four acres of newly-planted vines. Work is now being done at several places where bogs of considerable size are being prepared for planting. They range in size from one acre to fifty acres. The greatest development is taking place at the mouth of the Columbia River in Pacific County, Washington, and Clatsop County, Oregon. In Pacific County work is being done on probably 150 acres which will be planted to vines next spring (1913). In Clatsop County work is being started on about 30 acres, which will probably be increased to from 50 to 70 acres by spring.

It would be practically impossible to give any approximation as to available cranberry land on this Coast. It is not probable, however, that there will be over 2,500 acres planted within the next twenty years, a great part of which will not produce large crops by reason of improper management and lack of essential natural conditions. It is not likely that the bogs on the Pacific Coast will ever be able to supply the demand of that section of the country. Like all other industries and in all other districts, there will be many bogs prepared on land where the soil and other conditions are not suitable, and by improper management and lack of finances there will be many failures. Where proper care has been exercised in selecting the bog and in its preparation and the natural conditions are right cranberry culture should be profitable on this Coast.

Cranberry culture was established about one hundred years ago in Massachusetts, about sixty-five years ago in New Jersey and about thirty years ago in Wisconsin, although the berries were gathered from the wild vines many years before that. These three states at present produce practically all the cranberries sold. Cranberries are produced in small quantities in about one-third of the states. Wherever cranberry culture has been attempted in the proper manner and under the proper conditions it has always proven very profitable. The failures are nearly always on account improper management or lack of necessary natural conditions. Cranberry culture has many advantages over many other lines of fruit culture. There is not the amount of laborious work connected with it; it requires very little equipment, no horses, a minimum amount of hired help; there are several months in the year when no attention at all is required. With the proper bogs and management there is no danger of crop failure. There is always a ready market for the product. The crop is not perishable and the season for harvesting is long as compared with most other fruits. There is no danger of an overproduction, as the amount of available land is very limited. There is no substitute for cranberries. The cost of production is small, leaving a large margin of profit. The consumption of cranberries can be greatly increased by proper educational advertising. It would be hard to find a more congenial occupation than cranberry culture and there are many other advantages. There is probably no other line of fruit culture which will be as favorable as cranberries as an investment, for safety, profit or as an occupation where the conditions are right. There are few investments, either industrial, mercantile, commercial or public utilities, which will equal a good producing cranberry bog for safety and profit. It is not likely to be hampered by difficulties with labor organizations. The success of a cranberry bog, just as in any other business, depends upon the management, but as the margin of profit is large it will stand considerable mismanagement before incurring a loss. It is an industry which will not likely be bothered by public regulation.

All economic plants show a preference for certain soils and other natural conditions, and none is more exacting in this respect than the cranberry, but when these conditions are once secured there is none that can be more easily and successfully grown and return more profitable crops. These conditions are well known and easily recognized by anyone who will take sufficient interest to secure the government publications and exercise moderately good judgment in selecting a location. Experience has proven that acid peat soil, free from silt and clay and free from salt, is the best adapted to profitable cranberry culture. It is practically the only soil on which lasting success is assured. It is preferred that this peat be at least two feet deep, and it will probably be better if it is deeper. A deep peat marsh will hold the moisture better than a shallow peat, and it is reasonable to suppose that a deeper peat will make a more lasting bog by reason of containing more plant food. An indica-

Picking Strawberries Between the Trees at Sunnyside, Washington

tion that the soil is suitable is the occurrence of wild cranberries.

Cranberries will only thrive in certain cliamtes, as there are only certain climates congenial to their successful culture. The climatic conditions where they can be successfully grown are limited. The occurrence of wild cranberries is an indication that they will grow, but care must be exercised to see that they yield abundantly also. A comparison of the weather records of the Pacific Coast with the records from the vicinity of other cranberry districts would indicate that the climatic conditions on this Coast are very favorable, particularly as to the length of the growing season and the number of days free from frost.

The topography of the land should be such that the water can be thoroughly and easily controlled for irrigation, flooding and drainage. The land should be almost but not perfectly level in order that it may be flooded by a minimum supply of water and in order that the water can be easily and quickly drained off after flooding. The drainage outlet should be located so that there will be no difficulty in securing fall to thoroughly drain the land. The land should be located so that there will be good air drainage, as this will greatly aid in protecting the crops from frost. The bogs of the Pacific Coast lie mostly at an elevation of between ten and twenty-five feet above sea level. Some of them are very close to the sea and some are several miles away. In the southern part of Oregon the bogs are mostly of small area, probably very few that have an area of over fifty acres. The largest bodies of bog are at the mouth of the Columbia River, where both in Clatsop County, Oregon, and in Pacific County, Washington, there are bodies of bog having areas of 600 acres. It is mostly in long, narrow strips, seldom over one-half mile wide. Experience has proven that to secure the highest success and a clean, lasting bog it is necessary, too, that there be an available supply of sand convenient to the bogs. The bogs should be covered with not less than three inches of sand. This is for the purpose of retaining the heat and moisture, prevents excessive weed growth, aids in frost prevention and in combination with the peat forms an ideal soil for the plants. This sand should be clean and free from silt, clay humus or vegetation and seeds. It is preferable that this sand be of a rather course texture.

Without doubt the most important requirement for a profitable cranberry bog is the water supply. It is the insurance of a profitable crop each year. While cranberries can and have been successfully raised without a water supply there is no question but that to get the best results it is necessary, particularly if the bog is of large acreage. The water must be fresh and there must be an abundant supply of it. It must also be situated so that it is accessable at all times and can be secured in sufficient quantities. It is used for the purpose of irrigation, flooding for frost protection, flooding for protection from insects and diseases, and in some localities it is used to flood the bogs during the winter to protect them from winter killing. The amount of available cranberry land is limited to that land which is otherwise suitable and can be supplied with sufficient water. It is estimated that it will require about six acre feet of water per acre each season for irrigation and flooding. The water supply may be secured either by gravity or by pumping. Where the water is secured by pumping it is sometimes possible to drain it back into the source of supply and the same water can be used over several times, thereby saving water. As the height to which the water is pumped is generally only a few feet the cost of pumping the water is a small item. The water supply must be so arranged that it can be put on the bogs within a few hours' time. The ditches must be large enough so that the entire bogs can be flooded at one time.

It is necessary that it be possible to arrange a drainage system so that all the surface water can be removed quickly and that the underground water be controlled to the depth required in order to keep the bog in the proper condition. As a general thing the underground water should be at least two feet below the surface, and some bogs will require a greater depth than this. The deeper the peat the lower the water will have to be held. On very shallow peat it may be advisable to hold the water within a foot of the surface. The drains should be of sufficient size to insure draining off all the surplus water used for irrigation and to remove the water used for flooding in a couple of hours. Dykes should be constructed along the drainage ditches of sufficient height to flood the bogs when desired. Gates should also be built in the ditches for the control of the water.

As in all industries there is a question of labor to be considered. In many it is very serious and the labor problem is seldom entirely satisfactory. In cranberry culture there is very little to be considered in the way of securing labor. Outside of the superintendence there is practically no skilled labor required. With the exception of the harvesting season there is very little labor required. The harvesting is done by unskilled men, women and children. It is preferable that the bogs be located in the vicinity of good-sized towns and cities where an available supply of labor can be secured. As the cranberry harvester can earn good wages, and as the fruit is not perishable and a couple of days' delay will not materially affect the crop, it is not likely that the grower will have much trouble in securing harvesters.

There will be a certain amount of equipment required both for construction and operating the bogs. This, however, will not be very extensive, and where large areas are being planted this will be a small item. This equipment will consist mostly of light machinery for scalping and sanding the bogs and pumps for the water supply. There will also be some sorting and grading appliances required. A very important part of disposing of the fruit is proper storage facilities. The crop is seldom disposed of as soon as harvested and is very often kept for several months. The storage houses should be located convenient to railroads to facilitate shipping. All the sorting, grading and packing should be done at the storage house. The prod-

uct should be handled as little as possible from the time it is harvested until in the hands of the consumer. Extreme care should be exercised in sorting, grading and packing the cranberries.

It is essential that there be a convenient way of transporting the crops to the markets. In the majority of cases this consists of both highway and railroad. A great many bogs are situated so that the berries have to be hauled long distances over rough roads. This should be avoided if possible, as it is very often the cause of considerable loss and at least is an item of considerable expense. The cranberry grower should have no trouble in disposing of his crops, especially if he belongs to an association which can control the distribution of the products. The consumption of cranberries is increasing very rapidly and by the proper educational advertising can still be greatly increased. The production of cranberries in the United States amounts to close to 500,000 barrels annually, which will amount to about one pint per capita. In addition to the fresh berries, which is practically the only way in which they are sold at present, there are opportunities for large profits in canning, preserving and evaporating the berries. In this way it will be possible to find markets where it is now impossible to ship the fresh fruit. At present the United States is the only country where cranberries are cultivated and it has the world for a market. There is no other fruit which can be substituted for cranberries and they have certain medicinal properties which are very valuable. It is not likely that there will ever be enough cranberries raised on the Pacific Coast to supply the demand of that section. As there is a freight rate of about two dollars a barrel from the Eastern bogs the price of berries on this Coast is fixed two dollars higher than the Eastern price.

Like all other organisms, the cranberry has its enemies and diseases as well as other hindrances. This may seem like a hardship to the grower, and to some growers it may be a hardship, but to the scientific grower it is really a help. By proper care all these insects and diseases can be controlled, and by proper management and study large crops can be produced every year, which will mean handsome profits to the careful grower. The careless and ignorant grower, by neglecting proper precautions, will produce very small crops and of poor quality. The hindrances which the grower can control are insects, plant diseases and weeds. With a sufficient water supply frost damage can also be readily controlled. Wind, rain, hail, extreme cold and heat are elements beyond the control of the grower. Fortunately, with the exception of a few localities, there is little to be feared from these.

The success of a cranberry bog will depend largely on the original construction, for after a bog is once planted it will last for generations.

Blackberry Vines Yield Prolific Crops at Sunnyside, Washington and the berries add to the farmer's income

There are bogs which have been producing for fifty years. On this Coast there are bogs twenty-five years old. After a bog is once constructed there is practically no cultivation required and a very little expense will keep it in shape. In the last few years there have been many improvements made in the methods of constructing the bogs. It has been proven that by using the best methods that the profits have been greatly increased. In Wisconsin on three classes of bogs, semi-wild, semi-clean and clean culture, the yield in barrels per acre were respectively 23, 46 and 94, which shows very clearly the advantages for the best intensive methods. Different locations and different conditions require different methods of handling. As the development on this Coast has not been extensive there have been practically no standard methods of performing the work.

A raw cranberry bog is mostly always covered by a growth of trees, brush or wild grass. Some bogs have only wild grass, which makes the clearing a comparatively small matter. Other bogs are covered by a growth of large trees and old, dead logs as well as other and younger growth, which make the clearing a serious and expensive item. Between these are all conditions of clearing. This clearing is done in a variety of ways, sometimes by hand, sometimes by machinery, and it can sometimes be done by burning or by a combination of all these methods. Where there are no large trees the clearing can generally be done very cheaply, as the roots of the trees spread out over the surface and do not penetrate deeply into the ground.

Ditches are first required to drain the land in order that it can be worked and later for the purpose of handling the water for flooding, irrigating and draining. The same ditches can be used for all purposes. The size of these ditches will depend on the amount of water to be handled. They should be of sufficient size to flood and drain the bogs within a few hours. In some locations the construction of these ditches is a considerable item, as very often drainage ditches have to be dug for several miles to secure drainage and very often the supply ditches are several miles in length. The small ditches are mostly dug by hand and the larger by small dredges. Every location will have its special ditch problems to solve. The depth of the ditches on the bog will depend to a great extent on the depth of the peat, as the deeper peat will require deeper ditches in order to secure the proper drainage.

In order to control the water when flooding the bogs it will be necessary to construct dams or dykes along the ditches. This can be done when the ditches are being dug or the dykes can be built from scalpings when the bog is being scalped. These dykes only need to be of sufficient height to flood the bogs, often one foot will be sufficient, except along the main supply ditches, where they should be at least four feet high. In order to control the water in the ditches and on the bogs it will be necessary to build gates and bulkheads, and perhaps some flumes. The number and locations of these will depend on the arrangement of the bogs. They are mostly built of lumber, but in some of the more important places they may be built of concrete.

The character of the water system will depend on the source of supply. The system should be so arranged that

the bogs can be flooded in five or six hours and drained off in a couple of hours. The supply may be secured from a living stream, a storage reservoir or lake. It may also be pumped from wells into a reservoir. It may be distributed over the bogs either by gravity or pumping. In some places it is necessary to control large areas in order to secure sufficient water, and also to construct large storage reservoirs. The design of the water system will also depend on whether the water is to be used for flooding or for irrigation, or both. It is sometimes necessary to carry the water long distances in ditches. Where there is sufficient water a gravity system will be the best. As there are few places where sufficient water can be secured by gravity it is probable that most of the bogs will have to depend on pumping plants. These pumps can generally be operated at a very low cost, and unless the gravity systems are very favorably located the pumping plants will be the most economical. Where a system can be so arranged that the bogs will drain into the source of supply and the same water can be used over several times, it will probably give as good results as any system.

After the land is cleared it is necessary to take some means to level it up and kill the surface vegetation. This is mostly done by scalping several inches off the surface and removing it from the bog. These scalpings are sometimes used for constructing the dams and dykes, and are very often piled and burned. Scalping is done by hand or by cutters and plows drawn by horses or engines. In some cases instead of removing the scalpings from the bog they are turned over and left on the bog. Where the original surface is smooth this method has given good results; it can be done by plowing and leveling the sod in some manner. Another method is to plow and cultivate the land sufficiently to kill the surface vegetation. Where the scalpings are removed from the bog wheelbarrows or small cars are generally used. Sleds hauled by either horses or an engine working on solid ground are also used. After the bog is scalped it should be graded to a uniform surface. Scalping will probably give the best results in the way of keeping the bog free from weeds, although it will depend on the character of the bog. There is a question whether when the bog is scalped and the scalpings removed if the best part of the soil is not removed. It is claimed by some growers that better results are obtained if the turf is left on the bog.

Continued in next issue

Making A Success of Raspberry Culture

By E. S. Ridge, Puyallup, Washington

I HAVE been growing raspberries in the Puyallup Valley for twenty-one years and have seen the output increased from 4,519 crates in 1899 to 83,648 in 1910. The people of the Puyallup Valley have made a success of growing raspberries commercially, and their success is due to three factors—first, the soil; second, organization; third, to their splendid shipping facilities. The soil of the valley is a sandy loam and is well adapted to raspberry growing. When I first commenced to grow raspberries our markets were Seattle and Tacoma, but soon the supply exceeded the demand and prices got to be very low, and the growers began to get discouraged. About 1895 several of the growers made a few shipments to Spokane with good results. In the following year we found that by careful picking we could get them into Helena and Butte. From that time on everybody shipped their berries east, but from lack of organization they often shipped all their berries to one place, which resulted in the cutting of prices in order to dispose of the berries.

In order to keep in touch with the markets and to equalize the distribution, in 1898 a co-operative association was formed, which gave us very good results for four years. Then we concluded that we needed a cannery to take care of our surplus and soft berries. To do this, in 1902, we reorganized into a stock association under the name of the Puyallup & Sumner Fruitgrowers' Association, and from that time we have succeeded beyond our expectations. This organization has made it possible to ship our berries in car lots to distant markets. It has made it possible to own and operate our own cannery. It has made it possible to get better service from the transportation companies. This association now has over 700 shipping members. As far as I am able to learn the Puyallup Valley is the only place in the United States that ships raspberries by the carload. During the season of 1910 this association shipped seventy-eight refrigerator cars, some going as far as St. Paul, Kansas City and Omaha. As to shipping facilities, all trains going east from Portland and Puget Sound points pass through Puyallup or make connections at Auburn. We ship on the Northern Pacific, Great Northern and Milwaukee Railroads.

The two leading varieties grown in the valley are the Cuthbert and Antwerp. The Antwerp is the best yielder and is the earliest to ripen, and when picked as soon as it begins to color ships well, but it softens. As soon as ripe it must be picked every day to ship well. It is no good to can in syrup. The Cuthbert is the best shipper and canner. If I were going to plant again I would plant only the Cuthbert. Raspberries in the Puyallup Valley are generally planted in rows six feet apart and three feet apart in the rows; the canes are supported by wires on each side of the row, about four feet high, supported by posts thirty feet apart. The canes are topped about five feet high in the spring; the fields are kept clean and given shallow, level cultivation. The best results are obtained by cutting out the old bearing canes as soon as the crop is gathered. This gives the growing canes more sun and air to mature fruit buds for the next season's crop.

From experience of my own and from experience of other growers, if I were to plant more raspberries I would plant in rows eight feet apart, with rows running north and south if possible. I would support the canes with wires as we ordinarily do, with this difference: I would raise the east wire about six inches higher or four and one-half feet. The cross arms that hold the wires would be thirty inches long, two-thirds of the length to extend to the east and one-third to the west. I would train all the canes to the east and fasten them to the wire by looping a strong twine around each two canes, and would not top the canes. The incline of the canes from the ground to the wire would give spring enough so that they would not break over the wire; the new canes would be kept all on one side and would not interfere with picking at all. The berries would be picked from one side of the row. The advantages of this system are easier and better picking, as the berries are all on one side of the row and are not tangled.

Now just a few words about picking and packing. Raspberries should be picked just as soon as they will come off the core without crumbling in picking. Place the first two fingers and thumb behind the berry and gently pull it off without much pressure. Do not hold many berries in the hand at once or they will be crushed and be spoiled for shipping, and do not put over-ripe berries in the same box with good, solid ones or they will not ship well. A soft berry soon moulds and spoils the whole crate. Fill boxes full, but do not round or heap up in the center or the cover will crush them. Take a little pains to level off the top of each box and do not let each picker fill his own crates, but have a packer do this. Do not let the sun shine on the berries after they are picked.

These recommendations are given as a result of my experience in growing raspberries commercially. My own berry fields are on bottom lands, but the berries seemed to do just as well on upland where the land contained sufficient humus; these uplands, however, were much lacking in that respect. To supply that deficiency they are planting winter vetch early in the fall to be plowed under in April for that season's setting. The vetch would then gain a sufficient growth to supply the needed humus. Clover and other leguminous plants are just as good for the purpose if they can be allowed a sufficient growth. I recommend the use of 150 to 200 pounds per acre of muriate of potash cultivated in early in the winter.

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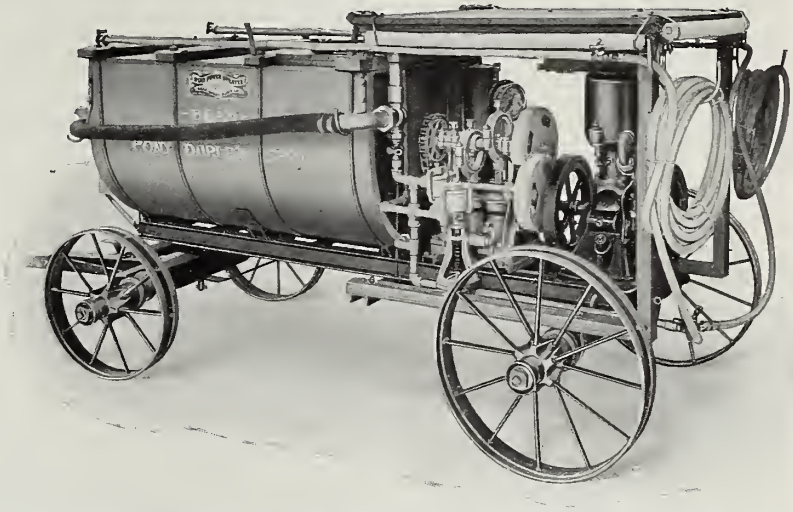

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Small Fruits.—During the last few years the interest taken in apples, pears and peaches has been so great that the growers, in their eagerness to get their orchards set, have been overlooking the valuable opportunities that exist in the small fruit business. Notwithstanding this fact, an immense industry has been built up in the small fruit business in several districts in the Northwest, as well as in Eastern sections. We speak of the Northwest because we are more familiar with conditions here than in the East. Hood River has for many years produced in the neighborhood of a hundred carloads of strawberries a year. Vashon Island, Lake Washington and Kenewick districts have developed large strawberry industries. Around Milton and Freewater are also successful strawberry growers, and for many years Puyallup and Sumner have produced large quantities of raspberries and blackberries and do a large business on a carload basis. All of these districts have conducted business in a profitable manner and good money has been made by small fruit growers in strawberries, raspberries and blackberries.

In comparatively recent years loganberries have been extensively planted in the Willamette Valley. Loganberries paid a good profit until the quantity became greater than the Portland market would consume. About this time the public became acquainted with the fact that the loganberry was one of the finest berries for canning for the purpose of making pies that was grown. A large canning industry has been built up and the entire production of the Willamette Valley is eagerly bought up early in the season by the canneries, consequently large acreages are being set and the business has paid a good profit per acre. In fact, the profit on loganberries, blackberries, raspberries and strawberries has averaged from $100 to $200 per acre net to the grower.

There are many districts where small fruits of proper varieties can be grown successfully and profitably, and we feel that we are justified in calling the attention of the fruit grower to this fact. Every fruit grower who grows apples realizes it is a long time from one season to another and it is mighty handy to have small patches of small fruits, well taken care of, which will bring in several hundred dollars in the summer season, when the apple and pear grower has no other source of revenue. There seems to be a keen appreciation of these facts among fruit growers in many districts, and much interest is being taken in the industry. We have, therefore, issued this splendid edition of "Better Fruit" devoted to small fruits, which we trust every reader will find not only interesting but valuable. All of the different kinds of small fruits are included in this edition, with suggestions about growing, the kinds to set, location, marketing, preserving, diseases and treatment.

Generally speaking, particularly in the Northwest, the small fruit industry has been engaged in only in districts on rather a large scale. In fact, they have only been grown in districts with a large number of growers producing a large output, the business being chiefly handled on a carload basis. Another field for the small fruit grower has been overlooked to a great extent. Surrounding nearly every town there is suitable land for small fruits. Many growers could engage in the small fruit industry in a small way, supplying their local trade with profitable results. In the summer the fruit grower has some spare time, and with a small berry patch of some kind could find time to harvest his crop and sell it direct to retailers in his own city, or deliver it to private customers if necessary, and in this way realize a handsome price. So far the small fruit industry seems to have been confined to strawberries, blackberries, raspberries and loganberries. There is always a good demand for gooseberries and currants at reasonable figures, but fruit growers in general seem to have overlooked these two fruits, which could be grown in many districts of the Northwest and for which there would be a ready demand in all local markets.

The small fruit industry has always been a paying business and probably always will be. Our advice would be for the grower to set a moderate sized patch, which he could properly take care of. The small fruit industry pays for intensified cultivation. The grower of small acreage in small fruits generally tills it well and meets with splendid success. The growers who generally make a failure of the small fruit business are those who have undertaken to grow too large an acreage—more than they could take care of in a proper manner.

Hood River was really placed on the map originally by strawberries, which made it famous. The Puget Sound country became known in the fruit markets of the Middle West through raspberries and blackberries. There is a regular trade in the Middle West for all we have grown in the past and all we will probably grow in the future.

The loganberry business was started in the Willamette Valley and is rapidly growing into a large industry. No one can appreciate the value of the loganberry until he has eaten a loganberry pie, and everyone knows what that is. The Aspinwall Brothers were among the earliest people to engage in the loganberry business in the Willamette Valley, at Brooks, Oregon, on the line of the Southern Pacific Railway near Salem. The Aspinwalls have met with splendid success, and now Mr. Britt Aspinwall is connected with a larger company and is setting out a large patch near the town of Independence, Oregon, where he considers the conditions very favorable for the production of this splendid berry.

The small fruit industry, outside of the sections mentioned, has had little or no attention in any of the other fruit growing districts in the Northwest, with the exception of strawberries, which have been grown quite extensively around Spokane and for which there is a ready sale locally. In fact, we might say very justly that the small fruit business has been generally ignored in the Northwest. While we believe in specializing in the fruit business, there are two sides to the question, and where the fruit grower has suitable soil and climate and a good local market, or where a district can engage in the small fruit industry in a large way so as to produce in carload shipments, we would suggest that the fruit growers read this number carefully and give the small fruit industry due and proper consideration. For the man growing a young orchard it is mighty handy to have a small berry patch of some kind which will begin to produce the first year after setting, and to the fruit grower who has an orchard already in bearing it comes in mighty handy to have the income that can be realized from a berry patch before the apples are harvested. We believe the small fruit industry is just in its infancy. We believe it is taking a start and the public will be surprised at the development in a few years. Wherever small fruits have been grown in sufficient quantities to justify the erection of canneries they have added much to the profit of the small fruit grower, because in this way all of the surplus, of which there is considerable, that is too ripe for long distance ship-

ments, can be disposed of at the canneries and will bring satisfactory returns, thus eliminating all waste.

Mr. Fruit Grower, kindly read this edition carefully and give the matter more consideration. You will certainly find that the income from a small berry patch is mighty convenient during the summer.

The November edition of "Better Fruit" contained statistics of the bearing and non-bearing fruit trees of all varieties of fruits in every state in the Union. It contains a lot of valuable information and anyone who has not secured a copy should do so early, as the quantity left is comparatively small. It is our intention in one of the early editions of "Better Fruit" to publish a review of the November edition, giving some of our opinions and summing up the apple situation in general, as obtained from careful study of the number of bearing and non-bearing trees in each of the different states.

The handsome illustration of the Loganberry produced on the cover page was furnished through the courtesy of Mr. Britt Aspinwall, who is in charge of the Oregon Loganberry Company, which is setting out about 200 acres near Independence. He was one of the early growers of the Loganberry at Brooks, Oregon, where he and his brother own one of the largest Loganberry yards in the world.

The Apple Season of 1912.—While this issue deals almost entirely with the small fruit industry, yet at the same time the apple season is at its height, and it therefore seems proper to say a few words about the condition. This year's crop is large all over the United States, with good quantities of apples to be marketed. The growers, associations and shippers throughout the country have pretty thoroughly understood the situation and realized the necessity of moving the crop early in the season, consequently all of the early varieties have been pushed on the market and all such varieties that have not keeping qualities have been hurried along. Every seasonable variety to date has been marketed. Prices that have prevailed so far have been low, when compared with previous seasons. Buyers have understood that a sufficient quantity of the crop must be moved during the early part of the season to realize a fair and reasonable price for the late keeping varieties which go into cold storage. As we have already stated in a previous article, it is the consensus of opinion that about sixty per cent of the crop should be marketed before January first, at the latest, in order to make a demand for the remaining forty per cent at fair prices.

"Better Fruit" has been the originator of many special editions on the fruit industry, which have commanded the attention of the fruit growers throughout the entire country. In October we presented our educational number of serving the apple in two hundred and nine ways for table use. We prophesied in October, in a journalistic phrase, that this number would be a "scoop." Our prophecy has been fulfilled. This edition has created more favorable comment than any other issue we have published. Apparently the public has been broad-minded and realized the value of this edition to the apple grower and consumer. There has been an immense demand, which is keeping up, for copies of this edition from all over the country. We have received many favorable letters from apple dealers in reference to this issue. Many have stated they would present this edition to the newspapers for editorial comment. We hope and believe that the influence of this number will be instrumental in creating a greater field for the consumption of apples by showing the people how to serve them as a delicious dessert. Quite a little can be done by the fruit growers of the Northwest if they will interview the hotel and restaurant proprietors in the different cities, calling their attention to the importance of serving apples, and let them also see to it that our apples appear on the bill of fare every day. Every city in the Northwest has Eastern visitors constantly, and there is no better way of educating the public as to the quality of apples grown in any particular district than by having them served properly at the hotels.

The Economics and Science of the Small Fruit Industry

By V. P. Gardner, Associate Professor of Horticulture, Oregon Agricultural College, Corvallis

WHAT can be said of the small fruit industry from the investment point of view? How much does it cost to get started in the business? How long must one wait before returns may be expected? What is the average cost of production of the crop? How large yields are obtained? What are average prices? What are the prospects of unloading fruit on glutted markets? How long may small fruit plantations of the different kinds be expected to last? How large an acreage can one grower handle successfully? What is the least acreage he should start with if small fruits are to afford his main income? These and many other similar questions are constantly being asked. Their answers should always be sought before one investigates the details of planting and cultural methods. They are of fundamental importance, for upon them depends success or failure from a commercial point of view. Satisfactory answers to these questions are difficult to obtain—more difficult than data on time and varieties to plant, cultivation to give, fertilizers and spray materials to apply and other questions relating to cultural methods. This is true because growers are often averse to publishing the data regarding their own plantations, because records of yields, prices, and especially costs, are not often kept, and most of all because the personal factor is very important. These facts, however, do not lessen the desirability of finding approximate answers to some of these questions. Granting the probability of wide variation in the results obtained by different growers, yet if we can find out something about the average result of the average small fruit plantation, the average season, we have something upon which more or less accurate estimates of the industry as a business may be based. It may be stated at the outset that no attempt is made in this article to present any new facts or new information relating to the small fruit industry, or even to present information that we already have from a new viewpoint. The object is merely to afford an approximate answer to a few of the many questions pertaining to the economics of small fruit growing.

The first general financial consideration on the part of the prospective investor is the cost of getting started, the cost of the investment; and the first specific financial consideration is the cost of land suitable for small fruits. It has often been said that poor goods are always costly—that poor land is expensive at any price. The experience of the small fruitgrower probably verifies this as frequently as the experience of anyone. Poor land usually makes for low or only very moderate yields, a high cost of production, inferior grades, low prices, and consequently small returns. There are uses to which poor, cheap land can be profitably put, but they do not fall within the range of activities of the small fruitgrower. On the other hand, while the best lands are very desirable for small fruit growing it does not follow that the industry is always most profitable on the highest priced lands. To make this point perfectly clear it may be assumed that one very good piece of land may be bought for $500 per acre. Another piece, unquestionably a little better, is priced at $1,000 per acre. Let us assume that the first piece, with good management, will produce 250 crates of strawberries per acre, the latter 300 crates. Assuming a selling price of $1.25 per crate and a cost of production of sixty cents per crate (not counting interest on the original investment) the net profit from the first piece would be $162.50 per acre, from the second it would be $195. However, $162.50 represents 32½ per cent interest on the investment of $500 per acre and $195 only 19½ per cent on the investment of $1,000. It is true that the higher priced land in this case would afford a greater income per acre, but would it not be much better (13 per cent better in fact) for the person with a given amount to invest to have more acres of the $500 land? Again, let us assume that a piece of $500 per acre land will produce 250 crates of strawberries to the acre; a piece of $300 land 200 crates and a piece of $100 land 100 crates. Which would it be best economy to invest in? Again, assuming a selling price of $1.25 per crate and a cost of production (exclusive of interest on money invested) of sixty cents per crate, net profits would be $162.50 per acre on the $500 land, $130 per acre on the $300 land and $65 per acre on the $100 land. These figures represent rates of interest of 32½ per cent, 43 1/3 per cent and 65 per cent, respectively, on the amounts invested per acre. However, it is manifestly unfair to assume the same cost of production per crate where only 200 or 100 crates are produced per acre as where 250 crates are raised. Without question it will take about as much cultivation, hand hoeing, pruning (if the crop is one of the bush fruits), feritlization and spraying per acre on the poor land as it will on the good. Cost of harvesting per crate will be as great or greater, and cost of packages, packing, hauling, etc., will be practically the same. This means that instead of a cost of production of sixty cents per crate on the poorer land the figures are likely to be seventy-five cents per crate on the $300 land and $1 or $1.10 per crate on the $100 land. In other words, the net profit is $100 per acre on the $300 land and $25 to $15 per acre on the $100 land. These figures mean rates of interest of 32½ per cent, 33 1/3 per cent and 25 to 15 per cent, respectively, on the amounts invested. The $300 per acre land would under these circumstances be the best investment, the $500 per acre land the second best and the $100 land the poorest.

While the prices of land, yields and prices per crate assumed are necessarily arbitrary, they more or less approximately represent prices that are actually paid and yields that are actually obtained in some sections of the country. Probably the figures given for cost of land range too high for average conditions. The principle that it is desired to make clear is that there is a certain price that may be

paid for good small fruit land that will give a maximum rate of interest upon money invested. This may be called the optimum price. To pay less than this for poorer or more for slightly better land means a lower rate of interest on the money invested, and from a strictly business point of view is less desirable than the optimum priced land. Of course, this optimum price will vary with locality and section, but anyone contemplating small fruit growing as a business should very carefully seek to find out what it is for the section in question. He cannot afford to pay much more for his land or much less. It may be stated that in general good small fruit land ready for the plow should be obtained for $100 to $300 per acre. Sometimes excellent land may be obtained for less.

Fortunately the equipment required to operate a small fruit farm does not involve a large investment. It will include a team of horses, harness, spring wagon, horse and tool barn, packing shed with appliances, heavy wagon, two plows (a two-horse and a one-horse plow), several cultivators, spraying apparatus, hoes, spades, shovels and a few other minor articles. The team will probably cost $300. This may be objected to as being too small an estimate, but in the writer's opinion a light team is better suited to the work about a fruit plantation than a heavy team. Plows, cultivators, hoes, shovels, pruning tools, spraying apparatus and wagons will cost in the neighborhood of $250. A horse and a tool barn sufficient to meet the actual needs of the small fruit farm will probably cost $300. A suitable packing shed may be built and equipment installed for about $200. At these estimates $1,050 would be required to equip a small fruit farm. Assuming twenty-five acres as about largest unit that this equipment would supply, the cost of equipment per acre would amount to $42. Attention is called to the fact here that in figuring the rate of interest that any of the small fruit industries yield upon the investment this cost of equipment should always be taken into consideration. This is one of the reasons why cost of production per crate on poor land is relatively much higher than upon good land. It requires just as extensive an equipment for twenty-five acers of poor land as for the same area of good land.

After the land is bought and equipped, how much does it cost to plant it with small fruits? This, of course, will vary somewhat with the kind of fruit planted, the variety, the system of planting used and many other factors. Plowing, harrowing, rolling, staking, etc.—in other words, getting the land ready for planting—will amount to about the same for each of the different small fruits—possibly $5 per acre. With rows three and one-half feet apart and the plants one and one-half feet apart in the row a little over 8,000 strawberry plants are required to the acre. At $3 per thousand their cost amounts to about $25. Raspberry, blackberry, dewberry and Loganberry plants average about $20 per thousand and it requires approximately 800 to the acre, making their cost about $16. Currants and gooseberries will average about 1,000 to the acre and their cost about $50 per thousand. Average cost per acre of planting all these small fruits may be estimated at $5. This means that the cost of plants and planting per acre amount to about $30 for strawberries, $21 for the cane fruits and $55 for currants and gooseberries. These costs should, of course, be considered as a part of the original investment, and the plantation when in bearing must pay interest on this as well as upon cost of land and equipment. Again attention is called to the fact that it costs exactly as much to prepare and plant poor land as it does the very best.

After the land is bought, equipped, prepared and planted the grower must wait before he begins to get returns—one year in the case of strawberries, two to three years in the case of bush fruits. Furthermore, during this time labor must be expended for cultivation, hoeing, fertilization, pruning, spraying and sometimes other practices, such as winter protection or irrigation. For the present this may be roughly estimated at $20 per acre per year for each of the small fruits. (See later for an itemized estimate of what some of these costs are.) Assuming that the land costs $300 per acre to start with, strawberries at the beginning of the second year, when they will begin to bring in returns, represent a total investment of about $414 per acre (this includes 5 per cent interest on the original investment for land, equipment and plants); the cane fruits at the beginning of the third year $449, currants and gooseberries $487. Assuming that the land cost $100 per acre to start with, the total investments at the time that the fruits are ready to come into bearing would amount to approximately $202 for strawberries, $224 for the cane fruits and $263 for currants and gooseberries. These are the real figures upon which rates of interest from returns should be computed, as they, rather than original cost of land, represent the actual amounts invested at the time that the plantations come into bearing.

Needless to say cost of production varies greatly with different fruits on different soils and with different individuals. The figures given here are probable averages. Cultivation per year will amount to $10 per acre, fertilizer (one-quarter ton high grade) $10, hand hoeing $5, pruning (in the case of strawberries the removal of the runners) $10, spraying, mulching or irrigation $10. (These three items are grouped together because the bush fruits are likely to require spraying and no mulching or irrigation, and strawberries either mulching or irrigation or both, and no spraying.) It should be noted in passing that these are all, with the possible exception of fertilizers, items of expense that must be incurred whether the land is good or poor, whether a large or a small yield is obtained. In the case of the fertilizer item the need is the greater on the poorer land. Total cost of culture per acre, then, amounts to $45. If 100 crates are raised per acre the cost is 45 cents per crate; if 200 crates are raised it is 22½ cents; if 300 crates are raised it is 15 cents. Converting these yields to the ton basis, costs per ton would amount to approximately $38, $19 and $13, respectively. Cost of picking averages about 25 cents per 24-

pound crate. Gooseberries may often be picked for less, though raspberries and strawberries often cost more. Packages for most of these fruits cost about 15 cents per 24-pound crate. Packing, handling and hauling will average 5 cents to 10 cents more. If the fruit is delivered to a cannery or other by-products establishment, handling and hauling will probably amount to about the same, but packages will not amount to more than three cents per crate, as they are usually returned to the grower to be used again. The cost of harvesting and marketing, then, ranges from about 33 cents per crate where there is a short haul and packages are returned to about 50 cents per crate where there is a longer haul and packages are not returned; or considering a ton as a unit these costs range from $27 to $50. According to these figures the cost of placing a crate of fruit on the market, assuming a yield of 100 crates to the acre and not including interest on the money invested, ranges from 78 cents to 80 cents; assuming a yield of 200 crates to the acre it ranges from 55 cents to 72 cents; and assuming a yield of 300 crates to the acre it ranges from 48 cents to 65 cents.

Here, again, it is difficult to present satisfactory figures. The yields of the small fruitgrower are probably more subject to the vagaries of season and climate than those of any other farmer, and no one knows better than he how prices fluctuate, not only from season to season but from day to day. However, the prospective small fruitgrower is not interested mainly in what are the highest and what are lowest yields and prices sometimes obtained, but in average yields and average prices, for it is these average yields and average prices that season after season he will get and must take. Of course, if he is a good fruitgrower he will profit by exceptionally high prices some seasons; he is also equally certain to occasionally suffer from low prices and low yields. Yields of 100, 200, 250 and 300 crates per acre have already been suggested in making some of the computations in this article. It is believed that these represent the average range obtained by small fruitgrowers. Yields of not more than 75 to 90 crates per acre are not uncommon, especially with raspberries and certain varieties of strawberries. Likewise yields of 400 to 600 crates to the acre are not unknown, though they are not very common. It is only with very productive types or varieties of small fruits, such as the Loganberry and Evergreen blackberry that they are likely to be often obtained. A yield of 100 crates is the equivalent of about one and one-quarter tons. Prices ranging from $4 to $6 per crate are often obtained for very early or very late fruit, especially of the strawberry.

Early gooseberries and currants often bring the grower 10 cents per pound, and very fancy raspberries and blackberries often bring as high as 20 cents or 25 cents per pound. On the other hand, when markets are glutted strawberries occasionally have to be sacrificed for 50 cents to 60 cents per crate, and other fruits accordingly. With these variations in market conditions it becomes extremely difficult to estimate at all accurately what the average grower is likely to receive for the bulk of his crop. Because canning-factory prices are less subject to fluctuation and also because they represent what may be considered "rock-bottom" prices they are the ones upon which the following computations are based. The grower who is reasonably well situated may feel certain that he will not have to sell for lower prices than these, and that with good management he may often realize much more. At the cannery strawberries usually bring about $80 per ton, Loganberries $80, blackberries $50, gooseberries $40-$50, raspberries $80, currants $40-$50. At these figures gross receipts from a 100 to 300-crate strawberry crop would amount to $96-$288. As 200 crates per

Kind of Fruit	*Tons Per Acre*	*Price Per Ton*	*Gross Receipts*	*Cost Delivered*	*Net Profit*	*Capital Invested*	*Interest on Investment*
Strawberry	2.5	$80.00	$200.00	$110.00	$90.00	$414.00	21.7%
Raspberry	2.5	80.00	200.00	110.00	90.00	449.00	20 %
Loganberry	4	80.00	320.00	153.00	167.00	449.00	37.4%
Blackberry	4	50.00	200.00	153.00	47.00	449.00	10.5%
Currant and Gooseberry	4	50.00	200.00	153.00	47.00	487.00	9.7%

acre is a good yield for a canning variety, $192 represents the probable income. The figures would be about the same for raspberries. Loganberries range from three to five tons per acre on the average, hence the income from that crop would be $240 to $440 per acre. Blackberries, currants and gooseberries should return $96 to $240 on a two to five-ton yield.

The gross receipts that have just been given certainly make the small fruit industry appear like a very profitable one. What are the actual profits? The following table giving average yields, cost of production, prices and amounts of original investment, as we have just figured them out, shows what is left in each case in the way of net profit and also what rate of interest this net profit is upon the amount invested. Attention is especially directed to the figures in the last column showing interest rates upon the capital invested, as these afford the real measure of the profitableness of the industry.

These figures may seem too low to many people. It is admitted that the net profit per acre is much lower than many people are actually realizing who are selling at cannery prices. It is because only very moderate yields are assumed. This has been done purposely so as to err on the side of conservatism rather than on the side of liberality. It is better business for the fruitgrower to slightly underestimate his yields and returns than to overestimate them. It should also be emphasized at this point that the prices assumed are cannery prices; that good markets for the fresh fruit almost always afford greater net profits. One very interesting fact stands out prominently from the figures just presented. The Loganberry apparently gives a very high rate of interest upon money invested as compared with the other small fruits. It is not the object of this article to "boom" the Loganberry industry. The object is only to get at the facts, and the facts are that the Loganberry is a heavy yielder (the four tons per acre assumed in this table is a very moderate yield) and that prices are good. Furthermore, it does not seem probable that its prices will go much lower, for as a fresh fruit and through its manufactured products it comes in the same class as the strawberry and raspberry, and their prices will always tend to hold its price up to its present level.

Attention may here be called to the very important relation of profits to the amount of the original investment, the cost of production and the yield. It is cost of production per crate or per ton that the fruitgrower should be mainly interested in rather than cost of production per acre. His selling unit is the crate or ton, not the acre. Difference between the cost of production per selling unit and price received per selling unit represents profit. The grower may think that by reducing the amount of, or eliminating entirely, the fertilizer by cultivating a few less times or by practicing some other economy (?) he is reducing his cost of production and thereby reaping greater profits. He does reduce his cost of production per acre, but in all probability yield is also so reduced that cost of production per crate or per ton is actually increased; and with increased cost of production per ton and fewer tons profits are greatly reduced. Odd as it may seem large yields and low cost of production per selling unit go together, and this combination is one of the first essentials to commercial success. The importance of buying land as cheaply as possible, provided it possesses good yielding ability, has already been emphasized.

The small fruitgrower is interested not only in making good profits per crate, per ton or per acre; in realizing a good rate of interest upon the money invested. It is also essential that he make a good living. This at once brings up the question of what constitutes a profitable unit for the small fruitgrower. It is one of the questions connected with the industry upon which there is much lack of information and about which misleading statements are often made. Let us assume, for the sake of illustration, that the Loganberry is being grown. With a four-ton per acre crop and an $80 per ton price profits would amount to about $167 per acre. Five acres would thus apparently afford a profit of $835, 10 acres $1,670, 20 acres $3,340. These figures, however, do not indicate what the total income of the grower would be provided he spent his own time upon his farm doing much of its work himself. He would probably be able to do most of his cultivating, pruning, hand hoeing, spraying and at least a part of his picking and hauling. Probably he would contribute about $30 worth of labor per acre toward the cost of production and marketing. This would amount to $150 on 5 acres, $300 on 10 acres and $600 on 20 acres, making the total income from 5, 10 and 20-acre Loganberry tracts $985, $1,970 and $3,940, respectively. A $985 income is certainly not to be despised. It is better than the average paid to laborers in almost any industry in the United States. In other words, a five-acre Loganberry investment (assuming, of course, a suitable soil, location and good management) is apparently capable of affording a very moderate income. Ten acres in this crop would apparently afford a very comfortable income—as good or better than the average person belonging to the great middle class receives. Twenty acres would afford an income capable of enabling the owner not only to live comfortably but also to enjoy many luxuries. Notice, however, that the word "apparently" has been used twice in the last three sentences. With the Loganberry yielding four tons to the acre and selling for $80 per ton the profits would probably not amount to $167 per acre on a five-acre tract, or even on a ten-acre tract. Cost of production per selling unit on such small areas would in all probability be higher than the estimates given. Those estimates were made assuming a 20 to 25-acre unit. It requires practically the same amount of equipment in the way of plows, harrows, pruning and spraying apparatus, barns, packing sheds, etc., to properly care for five acres as it does twenty-five. Furthermore, labor may be employed much more efficiently on the larger acreage. Thus the apparent profit of $835 on a five-acre tract would really be reduced to perhaps $500 or $600 with the very best of management, and to even less under many circumstances. With the 10-acre tract the apparent profit would be reduced relatively less. A 30 or 35-acre unit is not considered most economical on the average, because two teams and practically double the equipment required for 20 or 25 acres would have to be provided. The Loganberry, however, according to the figures given affords the greatest profit per acre of any of the small fruits. The strawberry comes nearer to being an average small fruit. Our figures showed a net profit of $82 per acre. This would amount to $410 on 5 acres, $820 on 10 acres and $1,640 on 20 acres. In the same way as with the Loganberry the income to the grower over what he has to pay out for supplies and extra labor may be considered about $540, $1,120 and $2,240 from units of these different sizes. Though somewhat less than the figures given for the Loganberry, it is evident that a 10 or 20, or better still, a 25-acre tract devoted to strawberries (again assuming suitable soil and location and good management) is capable of affording a good living to the grower. With the strawberry and other small fruits, as with the Loganberry, higher cost of production accompanies small acreages and real profits from them are very likely to be less than those given. The very important principle that it is

desired to emphasize here must be evident from the preceding discussion. High cost of production per selling unit is almost certain to accompany small units of area. Larger units of area (20 or 25 acres) can be operated much more economically. Furthermore, the average grower is interested not only in a good rate of interest but in a good income, and large incomes are associated with large volumes of business. Relatively large units of area must be provided if there is to be a large volume of business.

Many more questions of an economic nature should be considered by the small fruitgrower. Is it best economy to grow but one kind of small fruit, as strawberries, or is it better to grow several kinds? Is it best to grow small fruits only or to combine small fruit growing with the growing of vegetables or the large fruits? Space is not permitted here for even a brief consideration of these questions. It should be stated, however, that the discussion of certain questions in this article has been upon the assumption that the grower is entirely dependent upon his small fruit farm for his income. Should only a part of his income be derived from small fruits and a part from vegetables or large fruits the questions must all be considered from the viewpoint of the farm as a whole rather than from that of the acreage devoted to small fruits. Especially is this true of the question as to what constitutes the most profitable unit in small fruit growing.

Hybrid Raspberries and Blackberries

By Professor W. H. Lawrence, Hood River, Oregon

THE demand for raspberries and blackberries and their hybrids as fresh, canned or dried fruit is steadily growing. Of the varieties grown commercially few of them entirely meet the demands of the consumer. The grower finds even greater objections to many of them, since they show great ranges in adaptability to types of soil, injury by frost and susceptibility to diseases. Such a condition is expected, since most of the raspberries have originated from the European garden raspberry, the American blackcaps and the Amcrican wild red raspberry and the hybrids of the same, while the blackberries and dewberries are represented by five or six species and varieties as well as a number of hybrids of very variable characters.

As the wild raspberries and blackberries have been brought under cultivation the more promising sorts have been propagated by the fruitgrower and nurseryman by seed, cuttings and suckers. Variations have been secured in old and neglected fields, in commercial fields and through selection and propagation of accidental hybrids and seedlings appearing in the home garden. A lesser number have been produced through pollenation as handled by the plant breeder. The propagation, distribution and use of all these variations has given a large number of forms which are now under cultivation. The general tendency to try everything that is at all promising has been responsible for the introduction of so many sorts into such valleys as the Puyallup Valley in Washington and the Willamette Valley in Oregon.

It has been said by many engaged in the commercial production of bush fruits that we have far too many varieties. In part this is true. We are in need of new varieties showing definite characters and meeting certain demands, but we are in less need of so many forms so nearly alike yet so variable in size of plants, yield, etc. A brief survey in almost any of the large raspberry or blackberry fields will show that among the number are hills which do not produce fruit, or the fruit is small, the yield light, possibly of poor flavor and soft, or the fruit "shells" when ready for gathering. In fact the canes bearing full commercial crops will show untold variations in adaptability to conditions and the susceptibility to the attacks of insect pests, fungi and bacteria. The need of new forms and varieties is indeed evident. The question naturally arises, how are we going to secure plants better fitted to our needs?

A study of the conditions existing in the raspberry and blackberry fields of the Puyallup Valley in Washington convinced the writer that the problems are by no means few in number and are only exceeded by their importance. The two glaring needs were (1) fields of uniform growing plants that produce good yields of berries of good size, flavor and shipping qualities, and (2) plants that are not susceptible to the ravages of insect pests and fungus diseases. This article will only permit mentioning a few of the minor but important of the problems, and the following will suggest the great service that could be rendered through careful selection and breeding: (1) Basing our judgment on the flavor and the size of the seeds of the wild blackberry, the cultivated blackberries lack flavor and the seeds are so large as to be objectionable; (2) the Snyder blackberry, the leading commercial early maturing blackberry, is very susceptible to crown gall, anthracnose and is very badly injured by the leaf hopper; (3) the blackcap, a raspberry in greatest demand, cannot be grown successfully, since the plants soon succumb to the attacks of a soil fungus; (4) a water-loving hybrid of each of raspberry and blackberry is desired.

While connected with the Western Washington Experiment Station as plant pathologist, the writer, assisted by R. N. Miller, attacked these problems both from the viewpoint of the horticulturist and the pathologist. A brief statement covering the general plan of the work done will suffice to outline the general plan followed to secure the hybrids meeting the needs of the bush-fruit growers. Several plants of each of the promising commercial sorts of raspberry, blackberry, dewberry and their hybrids were secured and planted in a plot. Careful observations were made the following spring to note the condition in which the plants had passed the winter. The problem of selection was simplified by the total destruction of a number of forms due to adverse winter weather; of the remaining, one or two forms of the most hardy were placed in the greenhouse. As these plants came into bloom the anthers or pollen sacks were removed from certain flowers and the pollenating done by supplying the pol-

len from a flower taken from some other variety. To prevent further pollenation the flowers thus treated were covered with paper sacks until the young fruit had set. Since a large majority of the plants used were hybrids, promiscuous crosses were made on both raspberries and blackberries and combinations between them, some rare, if not profitable, forms were anticipated. Nearly two hundred such crosses were made, the seed was saved and planted in flats in the greenhouse and the young plants placed in the field when large and strong enough for transplanting. These hybrids are being studied at the Western Washington Experiment Station at the present time. Through the large number of crosses made a very large number of plants were secured. As anticipated, the individuals in some of the crosses did not resemble each other close enough in their general appearance to be classed in the same group. It is hoped that the commercial value of some of these forms will be superior to the forms from which they were originated.

The survey of the blackberry fields in the Puyallup Valley showed that there are great possibilities in the production of new blackberries. During the second year an additional number of crosses between blackberries and related forms were made. Of the crosses made, the following suggests a few of the problems and shows the attempt made to utilize the native species of Rubus: (1) To secure an early bearing, early maturing, heavy yielding bush blackberry free from the attacks of insect pest and not susceptible to crown gall and anthracnose; (2) a cross with the wild blackberry or dewberry to secure a better flavored, small seeded but better shipping fruit with a larger proportion of flesh; (3) to secure a hybrid of the blackberry and the salmon berry that will stand a greater amount of water, adaptable to planting on the large area of soils which at the present time is not utilized for fruit culture, since they are not well drained during the early growing portion of the season; (4) crosses with the Mersereau to secure a hybrid with a fleshy core. Adaptability of the varieties to conditions, the commercial value of each and the susceptibility of each form to disease were considered before the crosses were made. Space does not permit giving the list of crosses and the reasons for making them. Some suggestions as to the possibilities of hybrid raspberries and blackberries may be had by reading the article on "Insect Pests and Diseases of Bush Fruits" which appears in this issue of "Better Fruit."

Fertilizers for Horticultural Crops in Oregon

By Professor C. I. Lewis, Corvallis, Oregon

THE use of fertilizers in the State of Oregon has not been taken up in a very extensive or intensive manner up to date. This has been due largely to the fact that the state is very large and only a small proportion of our soils are yet under cultivation and the great majority are naturally very productive, since they are virgin soils. However, from observations that many of our orchardists have been able to make, changes will have to be made. We have got to pay more attention to soil fertility. This may result in different methods of tillage, use of cover crops, etc., and in the application of commercial fertilizers. Up to the present date the growers of small fruits and truck growers are about the only ones who have been using fertilizers extensively. In many of our regions the strawberry growers have been applying commercial fertilizers with very good results. In some cases this has been in the form of nitrogen, but in many cases in the form of potash, which the growers felt would give them a firmer shipping berry. The vegetable growers, particularly the onion growers, have been using fertilizers for years in large quantities. The onions are grown principally on the beaverdam soils, and these soils often run very low in potash, and in many cases an application has given very beneficial results. Other truck interests are beginning to use fertilizers. As far as fruitmen are concerned fertilizers have been used in a rather limited way up to the present time.

Some of the nurserymen and orchardists are using fertilizers of various forms with good results. The prune men are beginning to experiment with the use of fertilizers to increase the yields and size of the fruit. This experiment station at the present time is working on the use of fertilizers for prune orchards under various conditions, and also doing some work with the apple to ascertain whether certain troubles can be overcome. This work is still in the experimental stage and it will be a year or two before any definite results can be obtained. We can say, then, that the use of fertilizers in Oregon is still in its infancy, and this being the case there are certain conditions that need clearing up to a certain degree. Fertilizer men and the horticulturists need to come to a better understanding of each other. It should be understood by all dealers selling fertilizers that their clients know what they are getting, and it is certainly of great importance that the orchardists should know this. He should be educated to buy the special elements like potash, phosphate and nitrogen rather than to buy mixed fertilizers of unknown composition. He should know just what he is getting and paying for.

I am suggesting that our fruitgrowers divide their orchards into belts where they can use check plots, so to a certain area they can apply potash, to another nitrogen, to another phosphate, then make a combination of two and finally of all three, leaving ample space between the plats so they will not interefere with each other. Often in a country like ours there is a sentiment against the use of fertilizers. This is very foolish. We pride ourselves on our rich soils, and the use of fertilizers to us seems to make us admit that in many cases the soils are not in as first-rate condition as they might be. Our soils may be very rich soils, but yet many of them will be deficient in certain elements. Many of the soils of Eastern Oregon are low in nitrogen and some of the soils of Western Oregon low in potash, consequently these soils could, in many cases, be nicely supplemented. Again, a chemical analysis is often misleading. A chemist could tell us whether certain plant foods are deficient or whether certain injurious salts are found. He cannot, however, tell us the point that is most important, namely, how available are the plant foods in the soil. His analysis might indicate that there was enough potash in the soil for 1,000 crops of apples, yet an application of a small amount of available potash might give splendid results, and what is true in regard to potash would likewise be true of certain other elements. This gives us the matter in a nutshell, so to speak, that is, it is going to become purely an economic question. If the grower finds that a few dollars' worth of fertilizer increases the yield, or gives the fruit a better form, that his trees are in better condition, that his fruit has more character, he is going to use fertilizers, but the kind he uses will depend upon his local conditions. I believe that if our growers will try out some of these fertilizers in actual field experiments that they will find that in many cases great benefits will result. It is a local problem that each grower must settle for himself.

The bacteria in the soil are responsible for the transformation of humus and other green or raw manures into forms available for crop use. These germs work more rapidly when the soil is warm, but are probably operating to some degree at all times. They require a certain amount of moisture, but the amount of water that will still let them perform their work is surprisingly small. During a flow these organisms keep up their work, producing a form of nitrogen soluble in water, which results in a loss to the land. No crop to bind this nitrogen allows it to leach out and wash away during the rainy season never to be recovered. The wise method to follow is to grow a cover crop, preferably a legume, and turn this crop under in the fall or spring. This cover crop will bind the nitrogen and present it again to the soil, and in a form more easily prepared for the crop than when it was contained in the manure or humus of the year previous.—J. F. Nicholson, Bacteriologist Idaho Experiment Station.

Statement of the Ownership, Management, Circulation, Etc. of "Better Fruit," Published Monthly at Hood River, Oregon

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E. H. SHEPARD, Editor and Publisher.

Sworn to and subscribed before me this 30th day of October, 1912.

JAY P. LUCAS, Postmaster.

Strawberry-Root Weavel Pest

"No really satisfactory treatment is at present known for this serious pest," says Assistant Entomologist A. L. Lovett, Oregon Agricultural College, discussing the attacks of the strawberry-root weevil on beds in the Freewater-Milton district. "Fields do not generally begin to show the attacks until the beginning of the third season, and those planted in hills not so soon as those in the mat system. The Magoon and Clark Seedling are especially prone to attack, while the Gibson seems practically immune. Where fields were watered from the Hudson Bay ditch they were usually infested, though often absolutely free if watered from private wells. This indicates that the beetles from infested patches up stream crawl into the ditch and are washed down to fields below. As they cannot fly and can only crawl, outside agencies must be used for transportation any great distance. They feed and crawl at night, resting in darkened or sheltered nooks by day. Since the adult beetles feed on the foliage, spraying with one of the arsenical poisons would seem effective. But two factors argue against this—the beetles emerge and commence depositing eggs when the berries are in full fruit, and they have a wide range of host plants and are not heavy feeders, so avoid sprayed foliage, either feeding on other crops or waiting for new growth. I am trying out different materials with a view to repelling or killing the grubs in the soil. It is a great problem to obtain something which will destroy the grub and yet not injure the tender plant. One Freewater grower reports success in using ashes and lime on infested fields and then flooding with water. Another grower plans to flood the soil this fall after the picking season and keep the plants submerged several days. This should kill the grub, but just what the possible effect on the strawberry plants and young fruit trees will be is yet to be seen. The treatment would, at best, be confined to irrigated districts, which do not include all the fields infested. Since the beetles cannot fly, the barrier method may be used. A field of about an acre and a half is enclosed by a low fence such as, it is hoped, will keep the pest out. The weevil is a serious pest with many factors making its control a complex problem. We hope eventually for satisfactory solution and are not discouraged. We are at all times, however, glad of suggestion, reports of experience and observation from growers, and will appreciate any offers of co-operation."—Contributed.

How to Care for Weak Crotches

Many trees have weak limbs and develop bad crotches. In some cases these result from injudicious pruning, while often they are the expression of the natural habit of the variety. A familiar sight on our streets is the leaking of the large crotches of cottonwood. There is a strain at the point where the two large limbs meet, hence a partial splitting, making an opening from which the sap exudes. This leakage is unsightly; furthermore, weak crotches of trees are dangerous to life and property. Especially is this true in our climate, with its high winds and heavy, wet snows.

In most cases weak crotches may easily be braced. There is a right and a wrong way to do this. It is not uncommon to see the two parts held together by a chain or iron band These will serve the purpose for a while, but subsequent growth and increase in the thickness of the tree will cause injury. The portions of the tree bound will gradually become choked to death. The food which is made by the leaf is obstructed in its course down the stem. As a result more wood is formed above the band than below, causing a bulge and ultimately the death of the part affected.

A better method of strengthening a weak crotch is to run an iron rod through the two limbs which form the undesirable crotch. A hole is bored through the two limbs a short distance above the crotch. This hole should be made to fit the rod as nearly as possible; this hole will not injure the tree. The rod should have a large head at one end and be threaded for a large nut at the other. The rod is inserted and the nut screwed up tightly. A one-inch rod will support a tremendous strain, but the size will depend, of course, upon the size of the limbs to be braced.—W. W. Robbins, Colorado Agricultural College.

Currant & Gooseberry Maggots

Currants and gooseberries become wormy by the maggot of a small fly. The fly pierces through the skin of the young fruit and injects an egg. When the currants are fully ripe the maggots drop out and enter the ground, where they pass the winter. From the nature of the attack it is impossible to cope with this pest by any spray. The only vulnerable period in the life history of the currant maggot is when the insect has entered the ground. A light cultivation of the soil during the late fall will tend to mash some of the worms in the ground and will be a help in protecting next year's crop. However, since these plants have very shallow roots, care must be taken not to injure the root system of the bushes. Chickens do considerable good if allowed to scratch out the maggots at the base of the plants. It might be well to pick the entire crop early before any of the maggots escape. The fruit could be used for jellies and the presence of the worms does not impair the quality of the preserves. As it is, a good many worms in currants are unconsciously used by every housewife.—Contributed.

From January 6 to February 14 the Winter School of Agriculture, Horticulture, Forestry and Home Economics will be held at the Washington State Agricultural College, Pullman, Washington.

Preserving Natural Fruit Flavor

By Mrs. C. I. Lewis, Corvallis, Oregon

FOR all that men say and sing of the beauties and joys of June, a dish of June's strawberries in January proves still more tempting than when served in its proper season. Grown-up children, like little ones, have a keen relish for that which they may not have, or at least are not supposed to have, in the natural order of things. Hence greenhouses, keeping summer through the winter; and hence artificial ice toboggans and skating rinks, that children may verily "go sliding on the ice upon a summer's day." It is in an effort to cater to this natural perversity of human nature that the housewife is seeking more and more to prescrve in her jams, jellies, drinks and all canned products their fresh and natural flavor. Good as her canned fruits are and have always been, they have acquired in the process of cooking a flavor of their own, which classes them at once as a winter dish. Could she so preserve them as to retain, unimpaired, their natural flavor she could serve, rather, a summer dish in winter. To unseal for supper some winter evening a bit of actual imprisoned summer—fragrance and flavor of fruit fresh picked—were not this to make of her guests very gods, served by Hebe?

As anything which is cooked suffers a change of flavor, it is by very little or no cooking that the original flavor is to be retained. Much has been done in the way of canning, without cooking, both fruits and vegetables. I wish to speak specially of certain jams which can be most successfully made from small fruits—first, the sun-kissed or very slightly cooked jams, and, second, the uncooked jams. The sun-kissed jams are best made from such small fruits as will retain their wholeness under heating — strawberries, gooseberrics and Loganberries. Put into the kettle barely enough water to cover the bottom, then add a cupful (or other small measureful of berries and sprinkle over these an equal measureful of sugar; again a measure of berries and equal measure of sugar. Do not fill the kettle full, nor nearly so; rather use several kettles, with but little depth of fruit and sugar in each, in order that the under layer may not be overheated, and thus broken and too long cooked before the upper layer is heated

WHEN WRITING ADVERTISERS MENTION BETTER FRUIT

through. It is not desirable to stir the fruit as it is heating, for fear of destroying the wholeness of the berries. Keep over the fire only until all the fruit is thoroughly heated through, gently pressing the top berries down into the liquid as the sugar melts and juice forms. Avoid boiling. Secure the heating-through with the least cooking possible. Turn out at once upon large platters or plates, not piling up the fruit thereon but spreading it out in one layer, surrounded by the syrup that formed in the quick heating. Keep these plates and platters in the brightest sunshine for several days until the juice has thickened to the desired consistency. Then it is ready to be dipped into jars and sealed with parowax in the usual manner. The strawberries and gooseberries thus preserved, having remained unbroken in the heating have acquired an almost candied quality in the sunning process, and have a nuttiness and "chewing" character quite unknown in the old-fashioned "cooked-down" jams.

For making jams without cooking select such small fruits as can be thoroughly mashed. Strawberries, currants, raspberries, wild blackberries and Loganberries have been used by the writer with success. As in the sunkissed jams, take measure for measure of sugar and berries. Be sure that the berries are not over-ripe and that they are absolutely free from taint or blemish. Simply mash together in any convenient way with large wooden spoon or with potato masher equal measures of fruit and sugar. Be sure that not an unbroken particle of fruit remains. For greater certainty, keep the mixture within easy reach for several days before putting it into jars for setting away, and every day mix and stir and beat and mash until there can be no possibility that a particle of fruit has escaped unbroken. Then, after putting into jars for keeping, do not seal air-tight. Simply tie a paper over the top, or, if in jelly glasses, put on the jelly lids—anything to keep the dust out and let the air in. Keep in a dry place. I have kept these uncooked jams in kitchen cupboards all winter in perfect condition.

Because of the large amount of sugar used in making these jams, the more

WHEN WRITING ADVERTISERS MENTION BETTER FRUIT

acid fruits, such as currants, Loganberries and wild blackberries, are especially adapted to this way of preserving. Yet I hesitate in saying this for fear of casting reflections on strawberry and raspberry jams thus made. They are exceedingly delicious and make possible raspberry and strawberry shortcake (with truly fresh-flavored berries) in the dead of winter. Not that I like these less but because I like the others still more, do I specially praise the sourer berries thus made into jams. By the way, a shortcake with the uncooked currant jam for filling and served with whipped cream, is as delicious as it is unusual.

I would not leave the subject of preserving natural flavors without referring to the possibilities of the juice of the Loganberry as a drink. All who make its acquaintance give it a higher place in their estimation than grape juice has held. If one has the use of a press the juice can be extracted from the raw berries and bottled without heating. The acid of the Loganberry seems to be a natural preservative, and, provided the juice is properly bottled with perfect sterilization, will keep in its natural fresh state. For making Loganberry juice in smaller quantities under average home conditions the following is an excellent recipe, and the berries require so little cooking that the fresh flavor is practically unimpaired:

Put barely enough water in the bottom of the kettle to prevent fruit from sticking and burning. Fill with fruit and heat (do not boil) until the fruit is sufficiently softened for releasing the juice. Assist the softening process by mashing the fruit as it is heating in order that it may be over the fire no longer than absolutely necessary. Turn into jelly bags, drain and squeeze. Now sweeten the juice with one-third its measure of sugar. Heat to boiling point (but do not continue to boil it) and bottle at once or seal in fruit jars. This makes a rich syrup which should be diluted with four or five parts of water to one of syrup for drinking. With the opening of the Panama canal, which will give cheap transportation coupled with good advertising, this beverage has unlimited commercial possibilities. Those who once try these uncooked preparations will never return to the old processes. The natural jams mean better flavor with less work.

OUR SPLENDID CLUBBING OFFER

"Better Fruit" offers to its readers one of the finest lists of clubbing offers ever placed before the public in the Northwest.

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World's Work $3.00	Pictorial Review 1.00	
Everybody's 1.50	Woman's Home Com-	Garden Magazine.....$1.50
Delineator 1.50	panion 1.50	The Etude 1.50
"Better Fruit" 1.00	"Better Fruit" 1.00	"Better Fruit" 1.00
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Ameriean Magazine.....$1.50	Everybody's $1.50	Farm Journal (Philadel-
Cosmopolitan 1.50	American 1.50	phia) five years.....$1.00
Good Housekeeping..... 1.50	Good Housekeeping..... 1.50	Kansas City Weekly Star .25
"Better Fruit" 1.00	"Better Fruit" 1.00	"Better Fruit" 1.00
Total $5.50	Total $5.50	Total $2.25
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Through lack of space we are unable to give a more detailed clubbing list. Rates on all magazines will be given to any of our subscribers by writing "Better Fruit."

Important Diseases, Etc.

Continued from page 22

as not to be seriously affected. The disease affects the foliage primarily and makes its first appearance on the plants as minute purplish spots more or less thickly scattered. These soon enlarge and the center becomes pale gray or nearly white in color. The margin, however, remains purple, shading into brown toward the lighter area in the center. When numerous these spots may run together. In severe cases the leaves may gradually turn yellow, wither and die. In some cases the disease has been reported as being so severe that the plants were killed, though this condition has never been observed by the writer in Oregon.

Cause.—This disease is caused by a fungus known technically as Mycosphærella Fragariæ. The mycelium grows in the tissue, killing it and forming the characteristic spots. This fungus has two sorts of spores. Conidia or summer spores are borne on special threads of the mycelium which emerge from the tissues through the epidermis in tufts. These are produced during the summer and serve to disseminate the disease through the field. Another spore stage, known as the sexual, ascigerous or winter stage, may be produced later in the season. In this stage the spores are borne in sacks, several of which are found inside receptacles imbedded in the tissues. These are only found late in the season and are believed in general to serve the purpose of carrying the fungus over the unfavorable conditions of winter. In Oregon the fungus seems to spread all winter, and it is possible that the summer spores are sufficient to keep the fungus perpetuated.

Control.—Only healthy plants should be set. If possible plants should be secured from fields where the disease is not present. In any case, all diseased leaves from the plants should be picked off before planting. The practice of cutting and burning the foliage after

harvesting the fruit, as practiced in some sections of Oregon, is an excellent one, since it destroys many leaves affected with the disease. When the disease is severe, spraying should be practiced. Use the 4-4-50 formula of bordeaux mixture. In Oregon three spraying are suggested for trial, two in early spring before the first fruits are half grown and another about the middle of September or first of October.

Powdery Mildew of the Grape.—The only important fungous disease that is of special interest to grape growers in the Northwest at the present time is the disease known as powdery mildew. This is most serious on the European varieties and consequently is of special interest in California and those sections of Oregon where these varieties are grown. The disease may attack any herbaceous part of the vine. On the leaves the fungus appears in the form of white or greenish white patches of mildew. These may run together until the greater part of the leaf is covered. The fungus may also attack the young canes, beginning at the base in the form of small patches, or in severe cases the whole surface may be covered. The green or white mildew is easily rubbed off, leaving brownish spots on the canes which soon turn black. If severely attacked, the canes fail to grow or mature properly. When the disease attacks the blossoms they fail to set. If the young fruit is attacked when quite small the berries may drop off. When attacked when half grown they develop irregularly and the affected parts become hardened and the ripe berries are irregular in form. If the berries are severely affected they may crack and are thus made useless for table use or for market. If this cracking occurs early they may still be used for wine, though in moist seasons they may be attacked by various molds. The berries are usually not attacked after they begin to ripen. When only slightly affected, the berries may ripen without cracking, but are disfigured by spots or blotches, which reduce their value for market purposes.

Cause.—The cause is a fungus known technically as Uncinula Spiralis. This, like all the fungi commonly known as powdery mildews, grows more or less superficially on the surface of the parts affected. The fine, threadlike mycelium is largely external, sending short feeding branches into the epidermal cells of the host. From this superficial mycelium erect branches are formed, which break down into short cells or spores. When abundant these give the spots a powdery appearance, which accounts for the popular name of this and other related forms. These spores are spread by the wind and thus may come to rest on a healthy part of the vine. They germinate by putting out a thread of mycelium, which branches and attaches itself to the surface of the host and grows into a fungus plant which, when it has reached it full development, produces spores in countless numbers like that from which it grew. This stage serves to spread the fungus rapidly and is known as the summer spore stage. Later in the season another form of the fungus, sometimes spoken of as the winter or resting stage, is produced. This consists of closed globose structures borne on the mycelium and having peculiar spiral tipped threadlike appendages attached to the surface. These bodies called perithecia are just visible to the unaided eye, and the appendages mentioned above may be made out with a good pocket lens. Inside these perithecia, spores quite different in character from those described above are borne in numerous little sacks. The perithecia protect the spores until spring, when they rot away or become broken in some way and set the spores free. It is from the germination of these spores on the vines that the first new infection

of the summer spore stage starts in the spring.

Treatment.—Where this disease is serious enough to cause any amount of loss, the vines must be protected by some fungicide. It has been found that the best method is to dust the plants with dry sulphur. The fungicidal value of dry sulphur rests largely on the vapors given off during hot weather (above 75 degrees). Below this temperature the fungus does not grow well. If the vines are covered with a sulphur dust and the temperature rises above 75 degrees, the sulphur is volatilized and prevents the growth of the fungus. The vines may be dusted either when dry or wet with dew. They should not be very wet, however. An application should always be made when the blossoms begin to open. In some sections this is sufficient, in others a previous application when the vines are about six to eight inches long should be made. Sometimes three or four dustings are necessary. The vines should be carefully watched and when any signs of mildew are detected the vines should be dusted. Any method of application by which the herbaceous parts of the vine are completely covered with a very fine coating of sulphur dust may be used. The most efficient method is the use of some form of hand or knapsack duster, several forms of which are considered good. The best are of European manufacture.

Crown Gall (Bacterum Tumefaciens). The disease known as crown gall or black knot of the grape is not uncommon in the Northwest and in some localities is becoming so serious as to cause considerable loss to growers. The disease is widely distributed in this country and abroad, but occurs in its most serious form in those sections where European varieties of grapes are grown. On the grape, crown gall is found in two forms, as a root gall and as a cane gall. On cuttings and young plants the root form is found most frequently. These root galls are usually formed at a wound and consequently occur commonly at the graft union on grafted vines. On older plants the disease usually also attacks the stem, extending from the crown upwards. On the canes the galls are usually confluent and occur in lines running lengthwise of the stem. The effect of the galls is to stunt the vines. The leaves are frequently smaller and show poor color. The underground galls rot away each year and other rot producing organisms may gain entrance and

aid in finally producing the death of the vine. Abundant evaporation takes place through the galled tissue, since it is not as well protected by epidermis as normal tissue, and this results in lessened vitality. The cane galls commonly start from infection in frost cracks. They may also start in wounds made in pruning or in any other way. The disease is spread in the vineyard in various ways, as by the water of irrigation, use of diseased cuttings and by insects. There is a great variation in the degree of resistance of the varieties originating from the various species of grapes. In general, European varieties, especially those originating from the species Vitis Vinifera, are quite susceptible, as are also varieties originating from crosses with this species and American forms. Vitis Labrusca and Vitis Æstivalis are more resistant than Vitis Vinifera, and some varieties originating from these species are apparently immune. Varieties originating from the American species Vitis Rupestris and Vitis Vulpina are apparently resistant and some practicaly immune to this disease. In general, however, there seems to be great variation in the degree of susceptibility of the varieties originating from any species.

Methods of Prevention.—No remedy for plants that become diseased is known, and since no experiments have been conducted in Oregon regarding the use of resistant stock, no definite recommendations can as yet be made. As pointed out above, certain stocks are notably resistant to this disease. In New Mexico, where crown gall has been particularly serious, it is found that such varieties as Rupestris St. George, Sweetwater, Seedless Sultana, Matoso and some other varieties are resistant on their own roots. Where it is desirable to grow susceptible varieties, it is recommended that these be grafted on resistant stock, and the best for this purpose has been found to be Rupestris St. George and Lenoir. The following varieties are found to be particularly susceptible to crown gall: Mission, Muscat of Alexandria, Flame Tokay, Malaga and Rose of Peru. It is suggested that it would be desirable for those who wish to experiment to try these resistant stocks in Oregon. Since the above mentioned resistant stocks are of southern origin, however, it may be found that they are not hardy under our conditions. In any case, cuttings should be secured where possible from vineyards free from disease. It is also recommended that they be planted deep as a precaution against frost and the resulting infection in frost cracks. It is best where possible for the grower to propagate his own stock, in order to avoid the possibility of introducing disease through cuttings or grafts grown in infected districts. In sections where frost is troublesome it would be desirable to protect the plants during cold weather by some covering.

Picking the 1912 Crop of Loganberries in Aspinwall Bros.' Yard at Brooks, Oregon

The Loganberry and Methods of Cultivation

By Britt Aspinwall, Independence, Oregon

SOME thirty or more years ago Judge J. H. Logan propagated a berry on his farm at Santa Cruz, California, by crossing a cultivated red raspberry and the Aughinbaugh blackberry (a species that grows wild in parts of California), the result being the Loganberry we have today. By combining the delicate sweetness of the red raspberry with the untamed sourness of the wild blackberry we have a natural flavor in the Loganberry which cannot be excelled. Loganberries are started from plants obtained by tipping the old vines in the fall of the year. The selection of plants in setting out a new yard is very essential, as a poor plant will make a weak vine which will seldom, if ever, make much of a growth or amount to anything.

Mr. Britt Aspinwall, Independence, Oregon, who is one of the owners of the Loganberry yards at Brooks, Oregon

We set our plants eight feet apart each way and cultivate them both ways during the first summer. This requires about 680 plants to the acre. Before setting them out the land should be put in first-class condition, then mark the ground both ways and take out a good shovelful of dirt for each plant, packing the loose dirt in around the roots with the hands so as to have them spread out as evenly as possible and keep them from drying out. We usually plant from the twenty-fifth of March to the middle of April, owing to the season and condition of the land. After the plants are set out they should be worked well each week or ten days during the summer with a disc harrow, springtooth and clodmasher to keep the ground loose and keep a dust mulch on the surface.

The vines will not make very much growth till about August, when they will begin to shoot out over the ground, and it will be necessary to turn them lengthwise of the rows and work the land only one way. At that time the holes should be dug and the posts set for the trellis. We use good cedar posts, putting them not over thirty-two feet apart in the row and two feet in the ground. This makes a trellis five feet high. Anchor the end posts good, as there will be a heavy strain on the wires when they are filled with ripe fruit. We use three No. 12 galvanized wires for the trellis, putting the top wire on top of the posts and the bottom one about twenty inches from the ground. In October the vines should be trained upon the trellis, spreading them out evenly so as to cover all the space possible and avoid bunches. It will be necessary to wind them around the wires, but not too tight, and the top wire will carry the most weight. If more plants are wanted train the vines over the wires with the ends down to the ground, and cover them about three or four inches deep about the first to middle of October. They will take root in the fall and winter and make good plants by the next March. We put ours down in this way and each year ship thousands of plants to all parts of the United States where they can be grown.

In the fall of the year plow the ground, throwing the dirt toward the rows, and leave it in this condition till spring. In the spring, as soon as the ground is in good condition to work, plow the dirt away from the hills, plowing very shallow closest to the rows so as not to disturb the roots. A vineyard plow is best for plowing the last two furrows, as one can get closer to the rows and between the hills without injuring the roots. It is a good plan to harrow close behind the plow if the weather is at all dry. This may be done either by hand or with a horse hoe. After hoeing them in good shape, which should be done soon after plowing, take a disc harrow and throw the

Aspinwall Bros.' Yard at Brooks, Oregon
The largest bearing Loganberry yard in the world

dirt back to the rows, but be careful not to ridge them too much in the row, as it has a tendency to raise the roots out of the ground. They should be worked with a spring-tooth harrow, or something similar, and clodmasher every week or ten days during the summer and up into July. When the new shoots start in the spring they should be trained up in the center of the hills, allowing them to stick out over the wires unless they get too long, when they will have to be turned back. Never thin out any of the vines unless they get thick in the hills, as it is apt to bleed the roots. I prefer not to trim off the ends of the vines, as we cannot see that they raise any larger berries, but fewer of them than when left as they naturally grow.

Picking season starts in from the middle of June to the first of July, and usually lasts about six weeks. It requires about four or five good pickers to the acre. As soon as we are through picking we cut out the old vines and train up the new ones, throwing the old ones between the rows, and cut them up with a sharp disc harrow so they can easily be plowed under and serve as a fertilizer. Loganberries should yield from one-third to one-half of a crop the next year after being set out, and thereafter a full crop. An average crop is from four to five tons of fresh fruit to the acre, although they sometimes yield as much as six and one-half tons on good, rich land. It requires about five and one-half pounds of fresh fruit to make one of evaporated. Loganberries may be put onto the market fresh, canned or evaporated. There is also a growing demand for Loganberry juice for flavoring and soft drinks. They also make an excellent wine.

PROTECT YOUR TREES FROM RABBITS THIS WINTER

The timeliness of this warning will be appreciated by those who have had sad experiences with rabbits in previous years. The question is, what is the most effective and yet the safe method of protecting trees? Most of you know the harmful effect of axle grease and other greases. Corn stalks, old rags or newspapers tied around the tree are not effective, as rabbits will gnaw through them. Screens, when left on for any length of time, make fine breeding places for tree pests. Old friends of Mr. Otwell will be glad to learn that his Tree Paint is now being manufactured and placed on the market again by the Minnesota Linseed Oil Paint Co. The formula and patents have been bought from Mr. Otwell, who was forced to discontinue his Tree Paint Business some time ago on account of other interests which demanded all his attention. Otwell's Winter Tree Paint contains no oil or grease—it is harmless to any tree, yet most effective in keeping off rabbits, field mice and other winter tree pests. It comes in powder form. You mix it with water and apply like whitewash. Besides protecting the trees against rabbits it benefits them in other ways also.
(Signed) GEORGE A. MURDOCK.

Insect Pests and Diseases, Etc.

Continued from page 18

determine a method of eontrol if it is possible to eontrol a disease of the nature of this one. The problem is one of the most interesting of the unsolved ones.

Powdery mildew, the perfeet stage of whieh has not been found, puts in an appearanee on the leaves of red raspberries following periods of moist weather shortly after the fruit begins to ripen. As a usual thing the disease does not beeome abundant enough to cause any injury. It is not uneommon, however, to see berries of the Antwerp type so eovered with the summer spores of the powdery mildew as to appear as if powdered with flour. There is a question whether these berries keep as well as non-infested ones.

The red spider and the red mite both attaek the red raspberry. The red mite gives us little or no coneern. The red spider, however, is partieularly injurious on the Antwerp, eausing much injury to the leaves by feeding on the under surface. The mites usually beeome abundant about the time the fruit is well matured in size. Severe infestation dwarfs the fruit and stops the proper maturing of late fruit. These mites are eontrolled with some diffieulty, sinee they proteet themselves by minute webs attaehed to the hairs on the under surfaee of the leaf. The eggs, which they lay in large numbers, are not readily killed by sprays. In eombating this pest, it has been found that thorough application of Black Leaf 40 and soap or kerosene emulsion give the best results, especially when applied with high pressure and a driving spray nozzle and direeting the spray toward the under side of the leaf.

San Jose seale and oyster bark louse both attaek bush fruits. They thrive best on blaekberries and dewberries. Owing to the fact that the bearing eanes are eut out each year, seale inseets do not eause serious injury.

A beetle known as the elick beetle, during the early portion of the season, have been known to eat out the terminal buds of young growing eanes and to also feed upon the blossom, eating out the glands produeing the neetar. Injury of this nature is rare, however, and has only been observed in patehes in whieh eherry trees were growing. These eliek beetles prefer the blossoms of the cherry, but when abundant attaek and destroy the blossoms of bush fruits.

The leaf hopper is a very eommon and injurious inseet oeeurring most abundantly on the leaves of the blaekberry. When the inseets become abundant the leaves beeome more or less mottled and a siekly-white eolor. The action of the inseets in sueking out the juiee and destroying the ehlorophyll or green eoloring matter of the leaf seriously interferes with the proper produetion of food materials and distribution of the same. These leaf hoppers when mature are winged, and when

abundant form white clouds as they rise from the infested plants. Near the close of the season eggs are deposited in the stems beneath the epidermis. Adults are also known to hibernate during the winter, but hibernation is of rather rare occurrence. During the spring when the eggs hatch, the young begin feeding on the under surface of the leaves. By delaying spraying until the older ones are beginning to form wings, an application of kerosene emulsion, thoroughly applied to the under surface of the leaf and with high pressure, will entirely rid the plants of all of the young hoppers. In case all the eggs have not hatched it will be necessary to make a second application at a later date in order to catch the remainder of them.

The raspberry cane maggot has proven to be an objectionable pest in raspberry fields. The adult of this pest is a fly. It lays its eggs on the young shoots of the raspberry and blackberries. When the eggs hatch the young maggots enter the tips of the shoots, tunneling downward through the pith for a distance of several inches, after which they encircle the stem, eating out the cambium layer, thus forming a complete girdle. Owing to the thickness of the cambium layer in raspberry shoots the girdle is usually effective. The top of the plant drops, turns black and dries up, thus arresting the terminal growth. In the meantime the maggot has entered the pith and is tunneling downward into the crown of the plant. The most effective way to control this pest is to cut off the girdled shoots several inches below the girdle as soon as the tip drops. Chickens allowed the run of berry fields will catch the flies while they are depositing their eggs. Allowing the chickens to run in the field and taking great care to destroy infested shoots will rid the berry field of this pest.

The raspberry root borer or the blackberry crown borer is a more difficult pest to combat than the maggot. The adult of this pest is a clear-winged butterfly which lays its eggs on the under surface and at the margin of the leaf. When the eggs hatch the young worms crawl down the stems and bury themselves beneath the epidermis on the crowns and upper portions of the roots. They hibernate in these places during the winter, but enter the roots and produce promiscuous tunnels during the first year. During the second year they work in the crowns and roots, forming large burrows. When ready to change to the papal state they eat out the pith in canes two to three inches above the surface of the ground, providing an exit through the woody portion. At the time of emergence many of the adult moths will be caught by chickens, which should have the run of the field at this time, and by birds. A very successful way to trap the moths is to wrap a piece of cheap mosquito netting around the base of each plant, thus trapping the moths until they can be collected and killed.

Wasps and hornets, especially the yellowjacket, become serious pests in raspberry fields during some seasons. In cases where a shortage of food for these insects occurs during the harvesting of the raspberry in particular, yellowjackets may be found feeding upon ripe fruit. Following heavy rains, at which time there is an excess of overripe fruit, these insects have entered berry fields in such numbers as to drive the pickers from their work. Invasion of the field by armies of these insects is only interesting from a scientific point of view, yet when under conditions where they have driven the pickers from the field financial loss has occurred from not being able to harvest the berries in time to market them as fresh fruit.

The Peach Mildew

By Professor Ed. Trumble,
Wenatchee, Washington

LAST spring the peach mildew became a rather serious pest in some of the peach orchards in the Wenatchee Valley. The peach mildew is a fungus disease that grows upon the leaves and fruit. This mildew appears as a white powdery substance on the leaves and peaches. On the peaches the white spots are definitely outlined and of various sizes. If allowed to increase unchecked these spots make the peaches unmarketable. The white powdery substance is composed of millions of spores, which, when distributed by the wind and other agencies to healthy trees and leaves, start the disease. This is why the disease spreads so rapidly when once started in an orchard.

The white thread-like structure of the mildew takes the food from the "green" in the leaves, thus robbing the tree of its food supply which has been elaborated by the leaves. Where the mildew is bad it kills the young shoots as well as the leaves. The mildew makes its worst attacks on varieties of peaches that have serrate leaves with small glands.

The mildew is a vigorous growing pest and the main difficulty in its control lies in the fact that most fungicides applied strong enough to kill the mildew usually do serious damage to the leaves. In my experiments on the canker I found that iron sulphide is especially free from scorching foliage. The cue led me to make a series of experiments in Mayor Gellatly's peach orchard, parts of which were very badly injured by the mildew. I tried out various formulae of iron sulphide, Rex lime and sulphur (1 to 25 and 1 to 30), flowers of sulphur dust, sulphuric acid (1 to 1,000), among other remedies.

The expcriment proved conclusively that iron sulphide, 6-50 formula, made as described for canker, was by far the best remedy. This spray killed the disease completely and did not burn the leaves. Iron sulphide is insoluble; this is why it does not burn the leaves. This spray is somewhat difficult to make, but it does the work. Six days

after this spray was applied tender shoots that were curled back and dying had straightened up, put out new foliage and were in a healthy growing condition. The improvement was remarkable. The iron sulphide must be a tonic, for simply killing the mildew can hardly account for all the improvement the trees made. Later in the season, when the peaches were more tender, a weaker solution of iron sulphide (the 5-50 formula) was used, i. e., five pounds of iron sulphate to fifty gallons of water precipitated with $1\frac{16}{100}$ gallons of Rex lime and sulphur solution, made as before.

Judging from the results obtained from the use or iron sulphide on peach mildew and the apple canker cytospora, especially since it kills the fungi without burning the foliage, I predict that this spray will become one of our best fungicides.

Losses in Barnyard Manure

In handling the barnyard manure the farmer can save or lose hundreds of dollars annually. A manure heap is a hotbed of bacterial activities. Some of the nitrogen is formed into ammonia and passes into the air; this is a clear loss. Some is transformed into nitrates, which are soluble, washing out by rains and sink into the soil or run off into the ditch; this also is a direct loss. Some of it is formed by bacteria into nitrates and these nitrates attacked by another species of bacteria which change into nitrogen gas, which passes into the air and is lost. Nitrogen is worth at least eight cents per pound, and a horse will produce fifteen tons of manure and litter per year, containing in round numbers one hundred and thirty pounds of nitrogen. At eight cents per pound the value of that manure is $10.40. It pays to save it. Experiments have taught us that liquid and solid manures, when kept together, deteriorate much more rapidly. Also that the more compact the manure is stored away from the weather the least loss will result. Here is a hint for the progressive farmer. Our farmers need this nitrogen, and when it represents at least ten dollars per horse one can afford to take a little better care of the manure produced by our stock.—J. F. Nicholson, Bacteriologist Idaho Experimenl Station.

A New Apple Cold Storage House

The Pajaro Valley has now a new apple and cold storage house, which has been used for the handling of this year's apple crop. It has capacity for 350 cars of apples, or 224,000 boxes. Besides this it has ample room for supplies and it is constructed so that its capacity can be increased at any time. This plant was erected by the National Ice and Cold Storage Company at the cost of $250,000.

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Insects Affecting the Grape, Etc.

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it get worked into the soil. Obviously, chickens should be kept out of the treated field. This bait kills the cutworms slowly, sometimes taking several days, but it has proved very effective, especially when used in connection with the bordeaux spray.

Erinose is the name given to a disease of grape leaves manifested by bright red spots. These are caused by a mite, after the fashion of the working of the pear-leaf blister mite. The disease has attracted some attention in California, but has been reported to me but once from Washington.

The commonest insects found working on strawberry plants in the Northwest include the following: Leaf folder, root weevil, red spider, grub of chafer beetle, crown-boring moth, flea beetles, cutworms, wireworms and a species of carrion beetle. The leaf folder is a small miller whose caterpillar folds or rolls the leaves together, sticking the folded edges together with silk. Within the retreat thus formed the caterpillar feeds. Later, after the crop is picked, the caterpillars pupate, but if the plants are mowed as soon as the berries are off and the tops burned with straw most of the leaf folders will be destroyed. This has been the usual treatment, but nowadays growers anticipate the working of the folder by spraying the plants early with arsenate of lead before the leaves are folded. The root weevil is a serious pest of the strawberry and has gained a secure foothold in the Northwest only during the last few years. It has already caused the extermination of many hundred acres of plants. It is a roundish dark weevil, less than a quarter of an inch long, with a hard shell. A related but rarer species is nearly three-fourths of an inch in length. These weevils produce maggot-like, fleshy grubs that feed on the roots, working mainly during the summer. A second brood may be produced in October, which hibernates as grubs. The first adult weevils of the year appear in June or July. Affected plants should be uprooted and destroyed, although such a procedure may not secure all the grubs. In the infested districts only such varieties of strawberries as crop in one year will be profitable. Suckering varieties will draw attack from the main plant, so that the hill system of growing should not be followed. Rotation of crops may be required to starve the weevils out of the soil, but it seems that these weevils are able to thrive in clover, timothy, etc., in which case rotation would not afford absolute satisfaction. As the adult weevils are wingless and migrate from one field to another by crawling, some growers have tried fencing with boards on edge, capped with projecting tin. Some dry summers the red spiders work great havoc in strawberry fields, scorching the fruit and leaves. A copious washing of the plants with plain water forced at high pressure

through a Bordeaux nozzle by means of a spray pump will often be effective, but requires repetition after a few days. The addition of a little sulphur lime increases the value of the treatment, but unfortunately sometimes may induce worse scorching than the red spiders. A tobacco spray is more reliable, but may taint the berries unless the concentrated Blackleaf 40 is used. The plants and adjacent ground may be dusted with fine sulphur, or if early in the season the old-time kerosene emulsion may be used.

Grubs of the chafer beetle seem especialy fond of strawberry roots. These pests are the big curled fishing grubs that are usually plentiful about a manure pile. Like the wireworms, they do not seem to be attracted by poisoned baits and have to be sought for one at a time by digging. Chickens are active in finding them, especially after cultivation. Grubs are also very partial to roots of sunflowers, and this plant is sometimes used as a trap crop at the edge of the field. As the grubs mainly require several years for the transformations one must not expect too speedy results from such a trap. In this connection may be mentioned the cutworms that live in the ground among the roots of the plants during the daytime. Uusually not till dusk do the cutworms emerge to feed. A poisoned bait, supplemented by bordeaux spray, as mentioned under grape insects, gives the best protection, but chickens can also be trained to search out cutworms to a remarkable degree.

The strawberry crown borer is the caterpillar stage of a clear-winged moth that somewhat resembles a wasp in appearance. The borer works in the heart of the plant and cannot be prevented by spraying or other simple means. The best treatment is to uproot and destroy any plants that may contain borers before the insects get out to develop, multiply and spread throughout the field. A carrion beetle, known as Silpha lapponica, has been observed to feed on the berries. Of itself it does but little harm, but since it is a filthy creature that passes its earlier existence in decaying animal matter it might infect the berries with poison. Most berries that have holes nibbled in them have not been visited by the carrion beetle, for birds and some insects may have done the feeding, but nevertheless it is not economy to use such fruit for food. The conspicuuous mass of "frog spittle" that is frequently found at the base of strawberry plants is produced by a little bug. Usually the spittle insect lives solitary and does not materially harm the plant, for it is scarcely poisonous, but some growers claim trouble when the insects become numerous. As the spittle insect announces its presence so conspicuously it can easily be gathered by hand, a far cheaper treatment than to attempt to spray for it.

The currant aphis and the fruit maggot are the most prevalent pests of these two plants. The aphis, working on the under side of the leaves, can be

checked by a tobacco spraying early in the season. Blackleaf 40, with soap added, makes a most efficient spray. Unfortunately there is no sure cure for the maggot. There are two distinct species of fruit flies that are responsible for these maggots. The flies bore into the young fruit with their tail-piece, injecting an egg into each berry. The presence of the maggot causes the fruit to ripen early, so that usually the reddest currants are the ones with worms inside. About the time the fruit is to be picked the maggots wriggle out, fall to the ground and there hibernate. Since the eggs are hypodermically injected beneath the skin there is no spray treatment available. The surest control measure would be to strip the plants before the worms emerge and either destroy the fruit or cook it into jelly. The presence of the worms does not affect the taste of the preserve. Otherwise, cultivation of the soil or the assistance of chickens will destroy some of the over-wintering pupae. As these plants have shallow roots, the cultivation of the soil cannot be deep enough to reach all the pupae. Other insects of less general occurrence are the caterpillars of sawflies and of the currant moth, which eat holes into the leaves. These species can be checked by an arsenical spray, although usually, since there seems to be great prejudice to the use of poison on these fruits, the plants are treated with buhach or hellebore. These insect powders may be dusted dry, mixed with flour as a dilutant, or may be steeped into a weak tea for spraying. Or, more simply, the insects may be removed by hand. A long-horn beetle and a clear-wing moth both produce borers that attack these plants. In these cases the infested plants must be removed. The cottony scale and a gall insect are usually found less troublesome.

Red spiders, leaf hoppers and wireworms attack the blackberry, raspberry and their relatives in the same fashion as those of the other small fruit plants. In addition, the bramble fruits have their own series of pests. Of these the commonest are the following: The cane maggot is the young of a species of fly, a very close relative of the common root maggot. The adults appear early in the spring and lay an egg near the tip of a shoot. The maggot, on hatching, works down the shoot a few inches and then girdles just beneath the skin. This girdling causes the shoot to wilt after a few hours and makes the infested stalks conspicuous. Pulling down the tip of an infested stalk makes it snap at the girdling. Such wilting shoots should be sought out and removed, cutting beneath the maggot. Infested raspberry shoots die, but blackberry shoots may outlive the injury. There are later maggots appearing through the season, and lateral branches may also be attacked. The stem borer, or raspberry-root borer, or blackberry-crown borer, as the insect is variously called, is the young of a clear-wing moth, which is

very like the crown borer of the strawberry. The moths lay eggs in late summer, the little borers hibernate in the canes near the roots and the next season work into the roots. Finally they ascend a few inches above the roots, through the pith of the old canes, and emerge as the moths. While in the old canes the borers should be destroyed, as the most practical method of controlling the pest. Again, the aid of chickens may be solicited in catching the moths as they emerge from the canes. A bud-weevil has been more or less destructive in very early spring, feeding on the opening buds. Jarring the weevils into an inverted umbrella has proved successful. The rose scale is sometimes found and requires a winter spraying of the sulphur-lime wash. For the stink bug that resents being disturbed by emitting its perfume, after the fashion of the skunk, there is no cure. The pale-green crickets, called the snowy-tree cricket, have a great fondness for laying their eggs in pithy stems. For this reason small fruits are often attacked. The mother insect pierces a double series of holes down the stem, laying an egg in each puncture. Should the punctured canes be numerous they should be removed and burned before the eggs hatch.

Cut Worms

Much damage to young orchards is done by climbing cut worms. These insects eat the buds and young foliage only during the night time. During the day they hide at the base of the tree, going down a few inches into the soil. The State Experiment Station recommends as the best treatment for this pest to scatter a poisoned bait, a spoonful to a tree. This is made by mixing dry one pound of paris green to twenty pounds of bran, then adding one or two quarts of molasses, and if possible the same amount of old beer. Work up with enough water to make a stiff mash before placing over the orchard. Do not let chickens have access to this poisoned bran. As a supplement to this treatment spray the trees with bordeaux made as follows: Five pounds of bluestone dissolved in twenty-five gallons of water and five pounds of lime slaked in twenty-five gallons of water. Mix the two. The same scheme of treatment will answer for the garden cut worms. If the poisoned bait be distributed before you set your plants or sow your seed you can work out the cut worms from the garden. After the plants have come up the bordeaux spray will help to protect them.

Tying bands of cotton around the tree trunks or painting with tanglefoot or axle grease, or fastening collars of tin or paper around the trunks are remedies that will not answer for our climbing cut worms. There are several other insects which feed on buds, foliage and garden produce which may not be killed by this treatment.—Contributed.

Strawberry Culture

By E. S. Wolfer, Eagle Point, Oregon

STRAWBERRIES are the source of much backache to some, and generally a fair profit. Eight persons out of every ten who engage in the growing of the strawberry for profit are losers at it financially. Some make mistakes in growing, a few in harvesting and many in marketing. Speaking from experience, will say that most of my mistakes were made in growing. I have always had a good market and no trouble during harvesting. The one thing that most berry growers fall short on is the thorough preparation of the soil. No matter how good your soil looks to you make it better.

First see to it that it is well drained. Tile drain if possible one year before planting to berries, and plant to some cultivatable crop one or two years before planting. "Gee," someone is saying, "that is lots of bother." So it is, but we want lots of berries. Second, fertilize heavily twenty-five to thirty loads of good stable manure (cow manure preferred), evenly scattered and well plowed under early in the spring, one month before planting to berry plants. Then get in with your disc cultivator and springtooth and make the ground as fine as you can, going over the ground once a week until planting time. Then use your float and marker. More depends on the soil than on any one other thing in berry growing. I have tried the good way and the other way. By the way, while preparing the soil just let a goodly flock of healthy hens help you. They will see to grubs, bugs, weed seeds and too many things to mention. My hens and chicks have the run of my berry patch up to the time that berries get ripe and they keep many a bug, etc., out of the berry plants.

There are several plans of marking out a field for berry plants. I take it that most of us are interested in the financial part, and that means planting so as to get the most out of the plants. I use both horse and wheel-hoe cultivator and set the plants sixteen to eighteen inches apart in the row, with the rows thirty inches apart, if for single-plant rows, and forty-two inches if for hedge row. Some varieties do better if kept in single plant rows, while others do well in hedge rows. I would not advise anyone to grow strawberries for Western trade in matted rows. That is like growing apples and peaches and not thinning them. In setting plants, if your soil is as fine as it should be a plant setter is a wonderful help both to the planter and the plant, and especially if the ground is dry and the day is hot, because it puts the roots down where they belong and applies the water at the same time. I have planted that way on a very hot day, with no rain in sight for weeks, and they did better than any of my plants set by hand.

If you are setting by hand use a dibble or a piece of heavy sheet iron

that is four inches wide and sixteen inches long. Have the blacksmith roll the top so it will fit your hand and make a V-point on the other end, so the dibble when finished will be twelve inches long below hand hold. Now with plants in any convenient carrier that will prevent roots from drying, get down on one knee beside row, dibble in right hand and plant in left. Set the dibble about six inches in the ground, pull the top toward you, insert the roots of the plant, take out dibble and set it in the ground about one and one-half or two inches from plant and press the soil firmly against the roots of the plant. More plants die from improper planting than from any one thing. Be sure that you firm the soil against the roots and up under the crown of the plant. No plant can live unless the soil is firm against the roots so that moisture and the fertilizer elements in solution in the moisture can be absorbed by the roots from the soil in close contact with roots of the plants. I have often dug up plants after setting that had seemingly grown for three months and blossomed and had fruit on, and had started some young runners and looked like ideal plants, and found that all the growth came from the crown of the plant and that root growth does not start very readily until the blossom drops and the berry is gone, and the plant gets ready for another crop by growing new roots above the old ones, and for that reason all blossom buds should be pinched off as soon as they can be conveniently gotten at, so the plant can and will put all its energies into root growing and crown building. If you want a hedge row (and with some varieties like Gandy, Glenn Mary, Parker Earle, Aroma and others) it is profitable to let one runner grow until it shows a small leaf, press that into the ground half way between and about six to eight inches to the right of the row, place a small stone or clod of earth back of the leaf-like formation so as to hold it in place and more readily root it. Do this to each plant. This will nearly double your crop. Large-growing plants need a little more room than that given above.

Now comes the operation that most people neglect. This is keeping the runners off the plants. The best way to learn is to let plants grow with and without runners until fruiting. That tells the story. The runners allowed to grow on berry plants sap the vitality of the strawberry plant more than the "crown borer" or a full crop of berries. Don't forget to cultivate and hoe. As soon as the plants are well set commence with the cultivator and hoe, going close to the plants and shallow, and if possible cultivate once or twice a week until fall or rains set in, in the Western States. And if you are growing plants in a climate where it gets very cold in October and November stop cultivating when the early frosts come along and let your plants ripen before putting them away for the winter. The last time through the row should open a

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furrow in the center between rows to drain the surplus water from the field when it rains. Then upon the first heavy freeze cover the plants with straw or straw manure for the winter to the depth of about two inches, parting this when all danger of freezing is past, early the next spring. West of the Cascade Mountains our berry plants grow until about December, when the roots become dormant. Even in this section a slight covering to the plants is a decided benefit. Some people ask, "Shall I cultivate my plants just before and during the main blooming period and while they are fruiting?" I would say this: That this period of the plant is a very critical one. Strawberry plants are shallow rooters and at this period of the growth the roots have reached as far on each side of the plant as is possible, and in cultivating if you disturb the roots the crop will suffer. Be careful about hoeing and cultivating deep or close to the plants at this time. Keep a shallow dust mulch if necessary if you cannot irrigate.

After your crop is picked don't give your plants a rest, as this stage in the life of the plant is one that needs attention. Just now the plant has finished bearing and is making runners, and its vitality is anything but at the top notch. The plant is weak from producing seed, so give it attention. Irrigate and cultivate and give a dressing of fresh stable manure. Get the plant into a healthy condition and starting a vigorous growth. Throw the soil toward the plant, as new roots will start above the old ones and they will need good soil to grow in to be feeders for the next crop. Keep the cultivator and hoe going and keep as many runners off as is possible. Two crops per plant are about as many as are profitable, although I have had four and five crops from the same plants that were profitable. Use plenty of wood ashes between plants; two or three handfuls between plants in the fall of the year will help wonderfully. Rake or hoe them in. Saltpeter, in solution of one ounce of saltpeter to ten or twelve quarts of water, applied during growing season in spring for young plants and after the crop is off for old plants, at the rate of one pint per plant every two weeks, is a good fertilizer and somewhat of an insecticide. It helps to keep the borer and grub away.

Someone will say "how about varieties?" My experience has been that varieties that do well in the Willamette Valley, such as Marshall, Wilson, New Oregon, William Belt, Dornan or Jim, and some others are no good here. They do not yield enough, and again varieties from a distance of 400 to 1,000 miles have to be acclimated. I now plant new varieties two years, that is, fruit first year, reset a runner and fruit again, before passing judgment on that variety. I saved an extra fine variety by doing that. The first crop was very poor. The crop from the reset plants was so good that no plants from that variety are fore sale. This season, 1912, plants of that variety bore two quarts

each of fine berries. All of the pickers like to pick the berries from that variety. I would suggest this: Look around and see what success your neighbor is having with varieties; plant the best only. The poor ones are dear as a gift.

As regards to the time of planting, I find the best results to be had from spring-set plants and August-set plants. In setting plants in the spring set as early as the ground can be prepared. If you grow your own plants leave enough soil on the roots so that they will start better when growing season opens. If setting plants in August be very careful to secure good plants, as it is impossible to secure dormant plants at this season of the year, and they must be given plenty of moisture and cultivation. If impossible to set plants in August I would not advise setting later than September 1 to secure berries in paying quantities the next season. Very few fall plants pay for themselves more than if you waited for regular season for setting plants in the spring. I prefer to set as early in the spring as the soil can be prepared. To those who are interested in berry growing I will say, experiment with varieties, seasons for planting, cultivating, pruning, etc. Don't take things for granted. No one man knows it all. There are but few varieties that are adapted to all soils or climates and markets. In propagating new plants select the most vigorous for yourself, then select the best from them. You will see a wonderful improvement. Persons growing for market should find out what the market likes and what it will pay for. I can generally get two and one-half cents more per pound on fancy berries. In my estimation a fancy berry is one of above medium size, regular shape, good color and a nice, large calyx, and, for select customers, fine flavor. There are few varieties that come up to the specifications. Of course, a firm berry is to be desired, but for local consumption it is not always necessary. Often growers have fine crops of berries and good markets for them, but they handle it in such a way as to lose money.

Do not plant more than you are sure you can handle. Rather have more orders at good prices than you can fill than to have more than you can readily sell at a poor price. In this way you will be better satisfied. I try to have nice berries for my pickers to pick. I let each picker have a six-box carrier and have them pick the culls in a separate box, and I generally have five boxes of fancy berries to one of culls. I sell my culls at five cents per box and fancy berries from ten cents to fifteen cents per box, and have no trouble disposing of them. Don't let any berries sit out in the field in the sun. Get them in the shade in a cool place as soon as possible. Pick all berries with a stem one-half inch long. Don't pull the berry off; pinch the stem in two with the thumb and forefinger. The market has never been glutted with extra fancy berries. Extra fancy berries as a rule can be shipped any dis-

WHEN WRITING ADVERTISERS MENTION BETTER FRUIT

tance, and for that reason the markets of one section cannot be flooded with choice berries from some other section. A grower of extra choice berries can rest easy as regards a demand for his other berries. Of course, some parts of this state are an exception to this rule.

Where there are a number of growers who find trouble in disposing of a good crop I would advise organizing or forming a producers' union for the purpose of buying and selling, and in this way reducing the cost of supplies to the individual and often getting better prices for produce. As a rule growers of strawberries plant varieties that come into bearing at the same time as their neighbors and in that way glut the local market. For distant markets this works well. I find that for local markets an extra early variety and an extra late variety are better than a medium season variety, and are generally better shippers. I have tried out thirty to thirty-five varieties, and for this section have only four or five varieties that are suitable, but expect to find several more. One variety tried out during the last two seasons is a late variety, blossoming after all danger of frost is past. Two or three others are more or less frost proof. After all is said and done the success of berry growing rests with the individual who cares for them.

Production of Small Fruits

By J. H. Rees, Glenwood Farm, Springbrook, Oregon

THE following paper is submitted for publication in your excellent paper with some knowledge of the wide range of climatic conditions in which your many readers live. We are located in Western Oregon and only attempt to write as conditions prevail in the Willamette Valley.

For the man of limited means the production of small fruits will often be found more practicable than apple growing. Early returns for the investment of money and labor and the greater certainty of crops will appeal to him as a better business venture, while the man with the larger capital may, under proper conditions, find ample scope in this field for intelligent business management as well. Most kinds of berries produce something of a crop the second year, and indeed a small crop of strawberries may be obtained the first year from early planting, though this is not usually advisable. For the small fruitgrower the market is all important. There is good land for the production of almost all kinds of small fruits and berries in all parts of the valley, but to make a success of the business one should be near a large town or city, to which he can haul his products and sell direct to the consumer, or be where enough other people are raising the same things he is raising, that he may combine with them in shipping to the market.

In our locality strawberies and blackberries are grown with some suc-

ces. The Gold Dollar, orginated by Zimri Mills of this place, is the leading strawberry, being early, fairly productive and of good quality. The crop is marketed through a local organization, the earlier shipments going to Portland, and as that market declines the shipments are diverted elsewhere. Our raspberries are American blackcaps and Munger. The first berries are marketed in Portland at fair prices, then the local cannery takes a quantity and the larger part of the crop is evaporated, for which product a satisfactory market has usually been found. Strawberries are planted either in the fall or spring in rows four feet apart, the plants about twenty inches in the row, and are gencrally kept in hills, though a few growers succeed well on strong soils with matted rows. Frequent shallow cultivation and good harrowing are essential, and good, clean land is important. Land with a good southern exposure that will ripen early berries is much to be preferred, since one crate of earliest berries gives as much net returns as half a dozen crates later in the season.

Raspberries should be planted in rows about seven feet apart, the plant tips about four feet apart in the row, the plant having been cross marked that they may be cultivated both ways the first season. When the young plants are twelve to sixteen inches high they should be pinched back, causing them to grow stocky and well branched. These branches will assume almost a trailing habit, and by covering the ends of these in late summer the best rooted tips for the next year's planting are obtained. In subsequent years the plants should be pinched back when twenty inches high. This early topping is important, since if left to grow tall the lower buds soon deteriorate and will not produce strong laterals even though the canes are cut back to proper height later in the season. Early the next spring they should be pruned back to twelve inches on all side branches and thirty inches high over the top. This will bring the crop of berries to a convenient height for picking and will not require wire to support the row. All bearing canes should be cut away as soon as the crop is harvested that the new growth may be better developed. A reversible disc is an excellent implement for cultivation, leaving the ground as nearly level as may be. The same rules apply to blackberry culture, though they may be topped a little higher. In many places we have noticed the berries pruned entirely too high, making harvesting quite inconvenient and wiring necessary, without adding one pound to the crop. Red raspberries find much favor in the market and have been more generally grown than the blackcaps, but being quite soft they are not so well adapted to long shipments. The habit of growth being upright from root suckers, they grow in a more matted row. Those like the blackcaps respond well to low heading and good cultivation.

The blackberry grows to perfection in Western Oregon, and a tract once planted will, with proper care, produce well for many years. We have had quite as satisfactory crops after twenty years' continuous bearing as from young plantings. The blackberry will not thrive on so wide a range of soils as the raspberry, much of our red hill land not being well suited to its culture. Of the standard varieties we know of none better than the Kittatinny and Lawton, the former preferred. The Mammoth is an excellent trailing variety, but often fails to fertilize well, causing many imperfect berries. The Evergreen is a semi-trailing berry, is a prolific bearer of the very best shipping fruit and when properly trained on wires is the easiest harvested. The long canes and leaf stems are very thorny. The seeds are large and hard, making it a second-rate berry with canners, and when once planted the vines are extremely difficult to exterminate.

Loganberries are just now claiming more attention than any other small fruit. What the caprice of future market demands may be we do not know, but much permanence is indicated by our largest canning concerns writing long-term contracts for the entire crop. When canned, processed cans must be used, as the acid of this fruit will very soon corrode the common tin can. When evaporated the Loganberry makes an excellent product, which is being well received by the trade. Much has been written on the culture of the Loganberry by those who have specialized with it, and to them we refer for desired information.

Currants are of comparatively easy growth and our markets have been but meagerly supplied with this dainty fruit. Gooseberries have been more generally planted. The Oregon Champion will remain our leading market sort. The markets were thoroughly supplied the past season and tons of the berries were not harvested. That grapes are not more universally grown for home use seems strange, when every home in the country and very many in the village and city might have an abundant supply with comparatively little effort. Most of the grapes shipped to our markets have been picked quite green, and grapes so handled never develop the rich flavor of ripe fruit.

That a better supply is coming from our local growers year by year is an encouraging incident in the movements to patronize home industry. The grower should get in closer touch with the consumer. Our ideal should be to supply every table with an abundance of good fruit at a reasonable price. It were much better to have a steady market for a large amount of small fruits—all fruits—than at great expense to produce a limited amount of very fancy products which the masses cannot afford to buy.

Northwest Fruit Growers' Unions and Associations

We publish free in this column the name of any fruit growers' organization. Secretaries are requested to furnish particulars for publication.

Oregon

Albany Fruit Growers' Union, Albany.
Ashland Fruit and Produce Association, Ashland.
Benton County Fruit Growers' Association, Corvallis.
Brownsville Fruit and Produce Association, Brownsville.
Coos Bay Fruit Growers' Association, Marshfield.
Coquille Valley Fruit Growers' Union, Myrtle Point.
Cove Fruit Growers' Association, Cove.
Dallas Fruit Growers' Association, Dallas.
Douglas County Fruit Growers' Association, Roseburg.
Dufur Valley Fruit Growers' Union, Dufur.
Dundee Fruit Growers' Association, Dundee.
Estacada Fruit Growers' Association, Estacada.
Eugene Fruit Growers' Association, Eugene.
Hood River Apple Growers' Union, Hood River.
Hyland Fruit Growers of Yamhill County, Sheridan.
Imbler Fruit Growers' Union, Imbler.
La Grande Fruit Association, La Grande.
Lincoln County Fruit Growers' Union, Toledo.
McMinnville Fruit Growers' Association, McMinnville.
Milton Fruit Growers' Union, Milton.
Mosier Fruit Growers' Association, Mosier.
Mount Hood Fruit Growers' Association, Sandy.
Newburg Apple Growers' Association, Newburg.
Northwestern Fruit Exchange, 418 Spalding Building, Portland.
Northeast Gaston Farmers' Association, Forest Grove.
Oregon City Fruit and Produce Association, Oregon City.
Rogue River Fruit and Produce Association, Medford.
Salem Fruit Union, Salem.
Santiam Fruit Growers' Association, Lebanon.
Springbrook Fruit Growers' Union, Springbrook.
Stanfield Fruit Growers' Association, Stanfield.
Sutherlin Fruit Growers' Association, Sutherlin.
The Dalles Fruit Growers' Union, The Dalles.
Umpqua Valley Fruit Growers' Association, Roseburg.
Washington County Fruit Growers' Association, Hillsboro.
Willamette Valley Prune Association, Salem.

Washington

Apple Growers' Union of White Salmon, Underwood.
Bay Island Fruit Growers' Association, Tacoma.
Brewster Fruit Growers' Union, Brewster.
Buckley Fruit Growers' Association, Buckley.
Cashmere Fruit Growers' Union, Cashmere.
Clarkston Fruit Growers' Association, Clarkston.
Cowlitz Fruit and Produce Association, Kelso.
Dryden Fruit Growers' Union, Dryden.
Elma Fruit and Produce Association, Elma.
Felida Prune Growers' Association, Vancouver.
Garfield Fruit Growers' Union, Garfield.
Goldendale Fruit and Produce Association, Goldendale.
Grandview Fruit Growers' Association, Grandview.
Granger Fruit Growers' Association, Granger.
Kalama Fruit Growers' Association, Kalama.
Kennewick Fruit Growers' Association, Kennewick.
Kiona Fruit Growers' Union, Kiona.
Lake Chelan Fruit Growers' Association, Chelan.
Lewis County Fruit Growers' Association, Centralia.
Lewis River Fruit Growers' Union, Woodland.
Mason County Fruit Growers' Association, Shelton.
Mount Vernon Fruit Growers' Association, Mount Vernon.
Northwestern Fruit Exchange, 510 Chamber of Commerce Building, Spokane.
Peshastin Fruit Growers' Association, Peshastin.
Pullman Fruit Growers' Association, Pullman.
Puyallup and Sumner Fruit Growers' Association, Puyallup.
Spokane County Horticultural Society, Spokane.
Spokane District Fruit Growers' Association, Spokane.
Spokane Inland Fruit Growers' Association, Keisling.
Spokane Valley Fruit Growers' Co., Otis Orchards.
Spokane Valley Growers' Union, Spokane.
Southwest Washington Fruit Growers' Association, Chehalis.
Stevens County Fruit Growers' Union, Myers Falls.
The Green Bluffs Fruit Growers' Association, Mead.
The Ridgefield Fruit Growers' Association, Ridgefield.
The Touchet Valley Fruit and Produce Union, Dayton.
Thurston County Fruit Growers' Union, Tumwater.
Vashon Island Fruit Growers' Association, Vashon.
Walla Walla Fruit and Vegetable Union, Walla Walla.
tion, Kent.
Wenatchee District Fruit Growers' Union, Wenatchee.
Wenatchee Valley Fruit Growers' Association, Wenatchee.
White River Valley Fruit and Berry Growers' Associa-
White Salmon Fruit Growers' Union, White Salmon.
Yakima Valley Fruit Growers' Association, North Yakima
Yakima Valley Fruit and Produce Growers' Association, Granger.
Yakima County Horticultural Union, North Yakima.
Zillah Fruit Growers' Association, Toppenish.

Idaho

Boise Valley Fruit Growers' Association, Boise.
Caldwell Fruit Growers' Association, Caldwell.
Council Valley Fruit Growers' Association, Council.
Emmett Fruit Growers' Association, Emmett.
Fruit Growers' Association, Moscow.
Lewiston Orchards Assembly, Lewiston.
Lewiston Orchards Association, Lewiston.
Nampa Fruit Growers' Association, Nampa.
New Plymouth Fruit Growers' Associatiou, New Plymouth.
Parma-Roswell Fruit Growers' Association, Parma.
Payette Valley Apple Growers' Union, Payette.
Southern Idaho Fruit Shippers' Association, Boise.
Twin Falls Fruit Growers' Association, Twin Falls.
Weiser Fruit and Produce Growers' Association, Weiser.
Weiser River Fruit Growers, Association, Weiser.

Colorado

Boulder County Fruit Growers' Association, Boulder.
Capital Hill Melon Growers' Association, Rocky Ford.
Crawford Fruit Growers' Association, Crawford.
Delta County Fruit Grwoers' Association, Delta.
Denver Fruit and Vegetable Association, Denver.
Fair Mount Melon Growers' Association, Swink.
Fowler Melon Growers' Association, Fowler.
Fremont County Fruit Growers' Association, Canon City.
Granada Melon Growers' Association, Granada.
Grand Junction Fruit Growers' Association, Clifton, Palisade, Grand Junction.
Kouns Party Cantaloupe Growers' Association, Rocky Ford.
Lamar Melon Growers' Association, Lamar.
Longmont Produce Exchange, Longmont.
Loveland Fruit Growers' Association, Loveland.
Manzanola Fruit Association, Manzanola.
Manzanola Orchard Association, Manzanola.
Montrose Fruit and Produce Association, Montrose.
Newdale Melon Growers' Association, Swink.
Palisade Fruit Growers' Association, Palisade.
Paonia Fruit Exchange, Paonia.
Pent County Melon Growers' Association, Las Animas.
Produce Association, Debeque.
Rifle Fruit and Produce Association, Rifle.
Roaring Fork Potato Growers' Association, Carbondale.
Rocky Ford Melon Growers' Association, Rocky Ford.
San Juan Fruit and Produce Growers' Association, Durango.
The Producers' Association, Debeque.
Western Slope Fruit Growers' Association, Palisade.

Montana

Bitter Root Fruit Growers' Association, Hamilton.
Missoula Fruit and Produce Association, Missoula.
Woodside Fruit Growers' Association, Woodside.

Utah

Bear River Valley Fruit Growers' Assn, Bear River City.
Brigham City Fruit Growers' Association, Brigham City.
Cache Valley Fruit Growers' Association, Wellsville.
Centerville Fruit Growers' Association, Centerville.
Excelsior Fruit and Produce Association, Clearfield (post office Layton R. F. D.)
Farmers & Fruit Growers' Forwarding Assn, Centerville.
Green River Fruit Growers' Association, Green River.
Ogden Fruit Growers' Association, Ogden.
Springville Fruit Growers' Association, Springville.
Utah County Fruit and Produce Association, Provo.
Willard Fruit Growers' Association, Willard.

New Mexico

San Juan Fruit and Produce Association, Farmington.

California

California Farmers' Union, Fresno.
California Fruit Exchange, Sacramento.
Fresno Fruit Growers' Company, Fresno.
Lincoln Fruit Growers' Association, Lincoln.
Lodi Fruit Growers' Union, Lodi.
Loomis Fruit Growers' Association, Loomis.
Newcastle Fruit Growers' Association, Newcastle.
Penryn Fruit Growers' Association, Penryn.
Sebastopol Apple Growers' Union, Sebastopol.
Sebastopol Berry Growers' Union, Sebastopol.
Stanislaus Farmers' Union, Modesto.
The Supply Company of the California Fruit Growers' Association, Los Angeles.
Turlock Fruit Growers' Association, Turlock.
Vacaville Fruit Growers' Association, Vacaville.
Winters Fruit Growers' Association, Winters.

British Columbia

Armstrong Fruit Growers' Association, Armstrong.
Boswell-Kootenay Lake Union, Boswell.
British Columbia Fruit Growers' Association, Victoria.
Creston Fruit and Produce Exchange, Creston.
Grand Forks Fruit Growers' Association, Grand Forks.
Hammond Fruit Ascsociation, Ltd., Hammond.
Hatzic Fruit Growers' Association. Hatzic.
Kaslo Horticultural Association, Kaslo.
Kelowna Farmers' Exchange, Ltd., Kelowna.
Kootenay Fruit Growers' Union, Ltd., Nelson.
Mission Fruit Growers' Association, Missionn.
Okanogan Fruit Union, Ltd., Vernon.
Queens Bay Fruit Growers' Association, Queens Bay.
Salmon Arm Farmers' Exchange, Salmon Arm.
Summerland Fruit Growers' Association, Summerland.
Victoria Fruit Growers' Exchange, Victoria.
Western Fruit Growers' Association, Mission.

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The HAYES is of thorough mechanical, up-to-the-minute construction from tank to nozzle. Special design 4-h.p. engine, high pressure triplex pump, improved agitator, cross reach orchard truck that turns in 14 feet, improved in every detail, the HAYES is sure, reliable, and easy in operation and guaranteed in efficiency.

The HAYES triplex pump has vertical ball, sure-seat valves, machine cut gears, drop forged crank shafts, high carbon steel pinions, tested to 500 pounds pressure, maintains 300 pounds pressure, forcing the solution in the smallest amount to cover the entire surface—in fact, a pump that really sprays and doesn't sprinkle.

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THE SPRAYER THAT REALLY SPRAYS AND DOESN'T SPRINKLE

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Arsenate of Lead is one of the most important of the "ORCHARD BRAND" products, and we manufacture the standard containing not less than 15% arsenic oxide (used by the government in the gypsy moth work in New England for the past four years).

We also manufacture a Tri-Plumbic (or so-called Ortho) Arsenate of Lead which is specially suited for sections on the Pacific Coast where the foggy weather during the growing period renders the standard grade dangerous to foliage and fruit.

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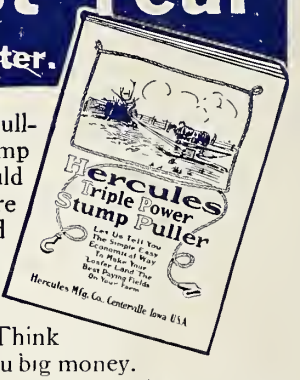

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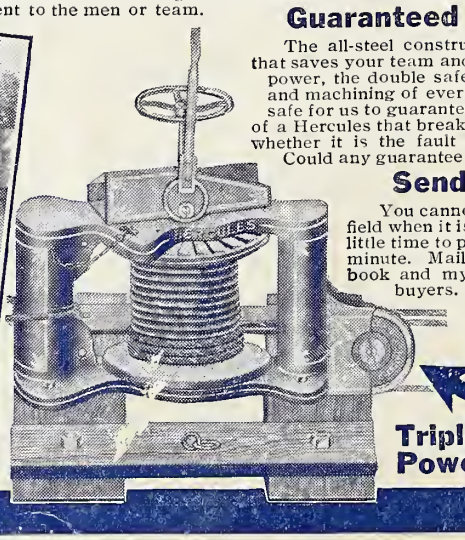

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